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Environmental Assessment: Source Test and Evaluation Report - Coal Preparation Plant No. 2

Versar, Inc.
Springfield, VA

Prepared for

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16. ABSTRACT

The report gives results and conclusions of a source test and evaluation program at a coal preparation plant, representing cleaning plants that process run-of-mine coal with high pyritic sulfur content, use high technology coal cleaning processes, operate in a high-rainfall environment, and have a low soil-neutralization potential. The major objective of the program was to perform an environmental assessment on the plant's waste streams and fugitive emissions. Chemical analysis results indicated that all streams, except fugitive particulates, contained constituents which may have a potentially harmful health and/or ecological effect. For streams showing potential for ecological effects, Mn was of concern; for streams showing a potentially harmful health effect, Mn and Cr were of prime concern. Contrary to previous studies, high NH_3 concentrations were observed in the leachate. Further investigation of the NH_3 source is warranted. Bioassays for fugitive particulates, sedimentation pond waters, and fine refuse slurry solid samples indicated moderate biological effects. For leachates, all health-related bioassays showed a low or nondetectable effect; however, the coal and coarse refuse leachate composite and the pond sediment composite produced a moderate effect on the ecological-related algae test.

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Coal Preparation	Aerosols	Stationary Sources	08I	07D
Assessments	Manganese	Environmental Assessment	14B	07B
Tailings	Chromium		13H	
Leakage	Ammonia	Fugitive Emissions	14G	
Processing	Bioassay	Particulate		06A
Sedimentation	Leaching			

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ABSTRACT

This report presents the results and conclusions of a Source Test and Evaluation Program conducted at a coal preparation facility. The preparation plant represents the group of cleaning plants that process run-of-mine coal with high pyritic sulfur content, use high technology coal cleaning processes, operate in an environment with high rainfall, and have a low soil neutralization potential. The major objective of the test program was to perform an environmental assessment on the facility's waste streams and fugitive emissions.

Results from the chemical analyses indicated that all streams, except for fugitive particulates, contained constituents which may have a potentially harmful health and/or ecological effect. For streams which showed potential for ecological effects, manganese was found to be of concern; for streams which showed a potentially harmful health effect, the heavy metals manganese and chromium were of prime concern. Contrary to previous studies, high ammonia concentrations were observed in the leachate. Further investigation of the ammonia source is warranted.

The bioassay test results for fugitive particulates, sedimentation pond waters, and fine refuse slurry solid samples indicated moderate biological effects. For leachates, all health-related bioassay tests showed a low or nondetectable effect; however, the coal and coarse refuse leachate composite and the pond sediment composite produced a moderate effect on the ecological-related algae test.

The results of this environmental assessment identified tailing ponds and associated sediments as the sources of greatest potential hazard due to high heavy metal concentrations.

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SECTION 1.0

EXECUTIVE SUMMARY

1.1 INTRODUCTION

Versar Inc., of Springfield, Virginia, under contract to the U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory (EPA-IERL) is performing a comprehensive environmental assessment of coal preparation technologies. A significant part of this assessment involves Source Test and Evaluation (STE) programs at operating coal cleaning facilities. The primary objectives of each STE program are to gather sufficient data to characterize multimedia emissions from the source, to assess that data on a health and ecological basis, and to evaluate the effectiveness of pollution control systems.

1.2 PROGRAM SUMMARY

One of the processes of particular interest in EPA's energy-related technology assessment programs is coal cleaning, especially because of its potential role in the control of sulfur dioxide emissions from industrial, commercial, and utility boilers. For several years, EPA has supported test work to investigate the usefulness of coal cleaning as a means of minimizing the pollution associated with utilization of coal.

The purpose of the coal cleaning aspects of EPA's assessment program is to establish a strong base of engineering, resource, emissions, pollution control, and cost data that can be used to determine which coal cleaning processes are most acceptable from the environmental, technological, and economic viewpoints. The data will also be used for pollution control trade-off studies comparing the various individual and combination techniques, such as coal cleaning combined with stack gas scrubbing, to reduce the pollution potential of coal-fired power plants. In addition, the data will be used to identify the areas where development of pollution control equipment is needed.

To characterize the overall control of emissions from coal use, it is necessary to assess the pollution potential of coal cleaning processes and allied operations. One phase of Versar's program for assessing coal cleaning processes involves a field sampling and analysis task designed to identify the combinations of coal cleaning processes and environmental conditions that most effectively reduce the total impact of coal use on the environment. The field testing program is being planned at selected coal cleaning facilities throughout the United States. The objective is to characterize effluent streams from a variety of such facilities and from their associated coal transportation, storage, and refuse disposal areas. Sampling points will be located upstream and downstream of pollution control equipment and of points of application of waste treatment techniques. This sampling scheme will determine the effectiveness of these pieces of equipment or techniques in reducing the potential pollution loading on the environment. Pollutant emissions of interest include leachate and runoff from coal storage and refuse disposal piles; sediment; leachate from slurry holding and disposal ponds; and fugitive particulates and vapors from coal handling and storage piles, refuse piles, and plant operations. Thermal dryer gases and particulates will be sampled at selected plants where the clean coal is dried. These field data will be obtained by conducting environmental source assessments of process and effluent streams using the sampling and analysis approach developed by EPA-IERL/RTP.

The field testing program is intended to determine the physical, chemical, and toxicological characteristics of effluent streams sampled at their respective sources, rather than to assess the environmental quality in the general vicinity of the cleaning plant. Therefore, results of the present testing program cannot be used to evaluate cause/effect relationships between effluent streams and ecological effects observed in the field.

The characteristics of the waste streams were evaluated by a standardized methodology developed by the Energy Assessment and Control Division of EPA's Industrial Environmental Research Laboratory at Research Triangle Park, N.C., for interpreting results obtained from environmental assessment test programs. This methodology uses Source Analysis Models (SAM's) which represent prototype approaches to multimedia, multipollutant problem identification and control effectiveness evaluation for complex effluents.

1.3 ENVIRONMENTAL ASSESSMENT TASK

1.3.1 Plant Selection

A coal cleaning plant site selection scheme was devised that assists in identifying plants in ten site categories for field testing. The site categories are based on four variables considered to be of prime importance in determining the pollution potential of any given coal cleaning plant:

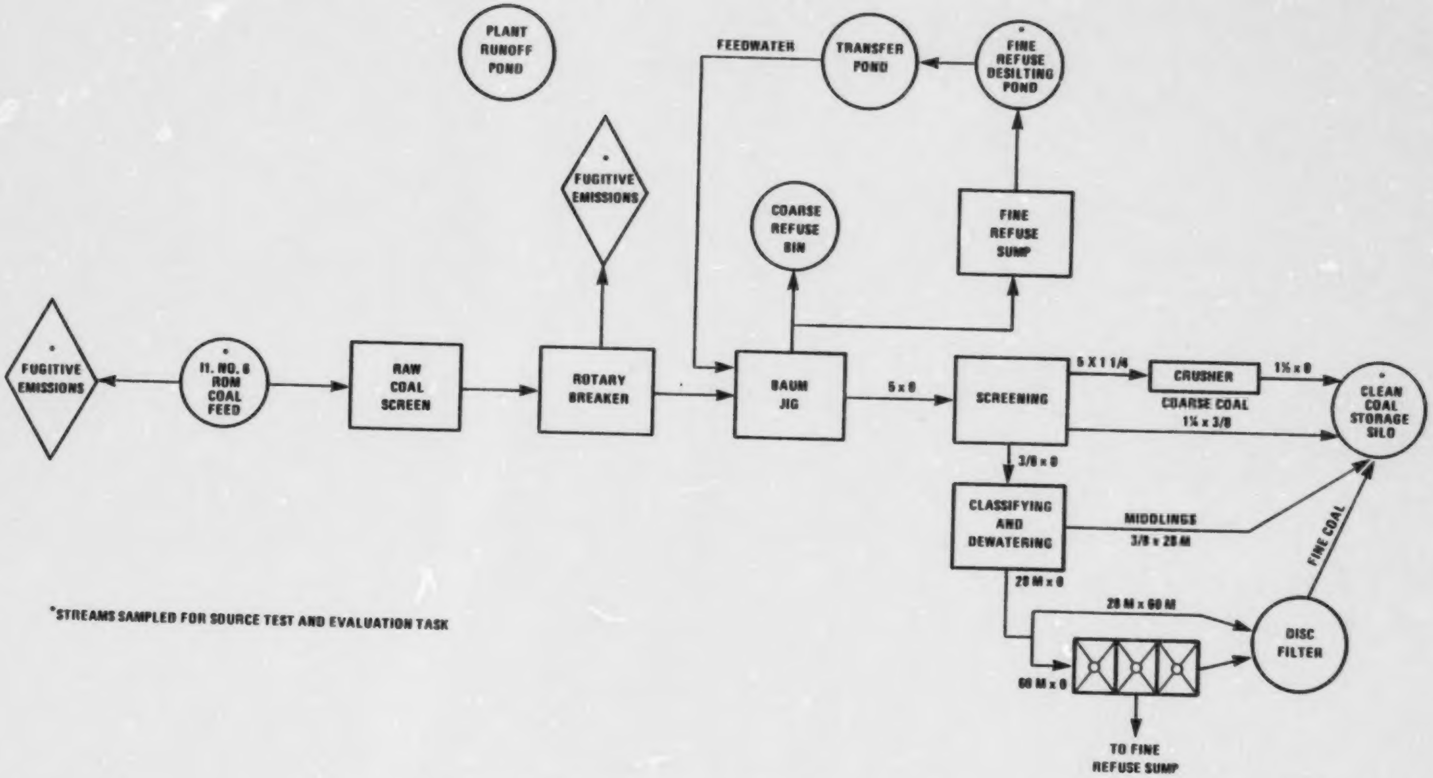
- Acid neutralization potential of the soil in the plant area.
- Pyritic sulfur content of the raw coal.
- Average annual precipitation.
- The relative sophistication of coal cleaning technology.

Although there are 16 possible combinations of these four variables, currently operating coal cleaning plants comprise only ten of the possible combinations.

1.3.2 Description of Coal Preparation Plant No. 2

The coal cleaning plant chosen for this assessment is located in southern Illinois and cleans Illinois No. 6 seam coal. Throughout this report, the facility will be referred to as coal preparation plant No. 2. Coal preparation plant No. 2 represents the group of cleaning plants that processes run-of-mine (ROM) coal with high pyritic sulfur ($\geq$2 percent pyritic sulfur) content, uses high technology coal cleaning processes, operates in an environment with high rainfall [$\geq$60 cm/yr ($\geq$25 in./yr)], and has low soil neutralization potential (pH $\leq$6.0).

A block diagram of the coal preparation plant highlighting major waste streams is given in Figure 1-1. The diagram shows that the stored ROM coal feed is screened over a stationary primary screen. The underflow is blended with the product from the rotary breaker and fed to a two-stage Baum jig for primary washing. The Baum jig produces a stream and a refuse stream, which is dewatered and sent to a coarse refuse hopper. The underflow from the coarse refuse screens is sent to the fine refuse slurry sump.


PLANT RUNOFF POND
FEEDWATER
TRANSFER POND
* FINE REFUSE DESILTING POND
* FUGITIVE EMISSIONS
COARSE REFUSE BIN
FINE REFUSE SUMP
* FUGITIVE EMISSIONS
* Il. NO. 6 ROM COAL FEED
RAW COAL SCREEN
ROTARY BREAKER
BAUM JIG
5 x 0
SCREENING
5 X 1 1/4
CRUSHER
1½ x 0
COARSE COAL
1¼ x 3/8
* CLEAN COAL STORAGE SILO
3/8 x 0
CLASSIFYING AND DEWATERING
MIDDLINGS
3/8 x 28 M
FINE COAL
28 M x 0
28 M x 60 M
DISC FILTER
60 M x 0
TO FINE REFUSE SUMP

*STREAMS SAMPLED FOR SOURCE TEST AND EVALUATION TASK

FIGURE 1-1 SCHEMATIC FLOW DIAGRAM OF COAL PREPARATION PLANT NO. 2

The middling and fine coal are taken from the washed coal screen underflow to classification and dewatering using a series of cyclones and screens. The middlings (3/8 in. x 28M) are further dewatered by centrifuges, then sent to the clean coal belt. The fine coal (28M x 0) is split into two streams, 28M x 60M and 60M x 0. The 60M x 0 material is fed to flotation cells for cleaning. The clean fine coal is then recombined, dewatered by a disc filter, and loaded onto the clean coal delivery belt. Fine refuse material, obtained from the cyclone underflow and flotation cell sinks, is collected in the fine refuse slurry sump. Fine refuse slurry is pumped to the desilting pond for disposal.

The clean coal from this plant is conveyed from the preparation plant through a series of conveyors to a 13,600 kkg capacity storage silo located approximately 700 meters from the plant. The storage silo feeds a rail train loading system and is situated over top of the railroad track.

1.3.3 Test Program Description

Samples of 20 process and waste streams were obtained to meet the objectives of this STE program. Because pond water and slurry stream samples were split into their respective solid and liquid states, and solids (non-fugitive) were treated for leachability, a total of 30 samples were analyzed to characterize the facility's raw materials, waste streams, and product.

Samples of 20 process and waste streams were obtained to meet the the following:

- Fugitive particulates and gases from the rotary breaker and ROM coal storage area.
- Fine refuse slurry.
- Fine refuse slurry desilting pond and transfer pond.
- Storm water runoff pond.
- Coarse refuse.

These streams were selected based on their potential for pollution and accessibility.

Analyses performed on the streams included:

- Chemical analysis by spark source/mass spectroscopy for inorganic element determination (all streams).
- Chemical analysis by inductively coupled argon plasma for certain inorganic elements (liquid streams only).
- Mercury analysis by atomic absorption spectroscopy (all streams).
- Chemical analysis for total chromatographable organics and gravimetric analysis for assessing total organic content (all gaseous, liquid, and sediment streams).
- Chemical analysis for general water quality parameters for each liquid stream.
- AMES test for mutagenesis (all streams).
- A second, suitable biological assessment test (all non-gaseous streams).

1.4 SOURCE TEST ENVIRONMENTAL ASSESSMENT SUMMARY

Preparation plant No. 2 is a 1,088 kkg (1,200 tph) coal washing plant. Its yield is approximately 888 to 912 tph of clean coal (i.e., 74 to 76 percent yield). The plant cleans Illinois No. 6 coal to a yield product that has an average sulfur content of 2.7 percent (as received) and an energy content of about 27,000 kJ/kkg (11,600 Btu/lb).

1.4.1 Sample Stream Characterization

To provide a rapid screening technique for evaluating the pollution potential of the waste streams, the simplest member of the source models (SAM/1A) was used. There are several assumptions implicit in the use of the SAM/1A evaluation technique, including:

- The MEGs methodology does not consider synergisms or antagonisms with regard to health or ecology. Severity is considered as simply additive.

- Persistence in the environment with regard to bioaccumulation or degradation is not specifically considered in the current MEGs.
- The level of confidence to be associated with MEGs values derived from the models is not known.
- Extrapolation of acute toxicity data for animals (i.e., LD_{50}) to no effects levels in man entails many assumptions that are not properly validated.

SAM/1A estimates a "discharge severity" which is the ratio of the specific pollutant concentration in an effluent stream to its corresponding health or ecological based Discharge Multimedia Environmental Goals (DMEG) value. For example, the estimated concentration of aluminum in the fine waste slurry filtrate sample was analyzed to be 190 μg/l. The health-based DMEG value for aluminum in a liquid discharge is 8.0×10^4 μg/l. To calculate the discharge severity (DS) value for aluminum, 190 μg/l is divided by the DMEG value, 8.0×10^4 μg/l, and the discharge severity is 2.4×10^{-3} or 2.4E-3. The Total Discharge Severity (TDS) can be calculated by summing the individual discharge severity values for each stream. It should be emphasized that DMEGs are not to be treated as regulations. They are designed for use in ranking chemicals on the basis of estimated environmental risk.

Except for fugitive particulate samples, all streams were found to contain some constituents in potentially harmful concentrations. Table 1-1 gives an overview of the test results for all waste streams. An "X" was placed in the first two columns if a waste stream contained one or more chemical constituents with a dischage severity greater than 1. The last two columns of the table summarize the significant biological results (i.e., moderate or high results for a health- or ecological-related bioassay). Because there were four possible health bioassays and three possible ecological bioassays, the table indicates the number of tests showing moderate effects out of the number of tests performed. The pond water,

TABLE 1-1. OVERVIEW OF TEST RESULTS INDICATING POTENTIAL FOR HEALTH AND ECOLOGICAL EFFECTS

Waste Stream	Individual Constituent(s) Showing a Discharge Severity Value Greater than One		Number of Biological Tests Showing Effects	
	Health	Ecological	Health	Ecological
Fugitive Particulates				
ROM Coal Storage Pile			1 of 2	NC
Rotary Breaker			1 of 2	NC
Upwind			1 of 2	NC
Downwind			1 of 2	NC
Vapors				
ROM Coal Storage Pile				
Rotary Breaker				
Upwind				
Downwind				
Filtrates				
Fine Waste Slurry	X	X	1 of 3*	1 of 3*
Desilting Pond Water		X	1 of 3*	1 of 3*
Transfer Pond Water		X		
Runoff Pond Water	X	X		
Runoff				
ROM Coal Storage Pile		X		
Solids and Leachates				
Dewatered Fine Waste Slurry	X	X	NC	NC
Filtered Desilting Pond Water	X	X	1 of 2	NC
Filtered Transfer Pond Water	X			
Filtered Runoff Pond Water	X			
ROM Coal	NC			
ROM Coal Leachate	X			1 of 3
Clean Coal	NC			
Clean Coal Leachate		X		1 of 3
Coarse Refuse	X	X		
Coarse Refuse Leachate	X	X		1 of 3
Desilting Pond Sediment	X	X	1 of 2	
Desilting Pond Sediment Leachate	X	X		1 of 3
Transfer Pond Sediment	X	X	1 of 2	
Transfer Pond Sediment Leachate		X		1 of 3
Runoff Pond Sediment	X	X	1 of 2	
Runoff Pond Sediment Leachate	X	X		1 of 3

* Biological tests performed on whole material.

NC - Not conducted.

fine waste slurry, sediments and sediment leachate samples show the greatest potential for health and ecological effects. A majority of the streams had a health-based TDS value of less than 100 and an ecological-based TDS value of greater than 100. The discharge severity is an index of the potential hazard of a single substance in a discharge. It is also used for evaluating the need for further characterization of the discharge (Level 2 environmental assessment) or development of improved control technologies. For solid streams with an ecological-based TDS greater than 100, the major contributor was phosphorus; for high health-based TDS values, the major contributors were chromium, manganese, and mercury.

The TDS value is an indication of the potential risk of harmful effects for an entire waste stream. TDS values may be ranked to indicate the streams that should be initial candidates for further characterization (Level 2 environmental assessment) or treatment. Figure 1-2 depicts the TDS values for all waste streams as a summary of the SAM/1A evaluation. The TDS values for all waste streams ranged from .002 to approximately 10,000 with the majority of the streams having a TDS value of less than 100.

Figure 1-3 summarizes the biological assay results. Twenty-eight samples were evaluated by the Ames Assay and were found to be nonmutagenic (low or nondetectable effects). Fourteen samples were evaluated by the CHO Clonal Assay and all were found to produce nondetectable cellular effects with the exception of two samples: the fine refuse slurry (unfiltered) and the desilting pond water, which produced a high cellular effect and a moderate effect, respectively. Five of the nine samples evaluated by the RAM assay produced toxic effects. The composite of desilting pond sediment and transfer pond sediment, and the runoff pond sediment sample results showed a high toxic effect. The filtered desilting pond water, the upwind particulates, and the composite of ROM coal pile, rotary breaker, and downwind particulates produced moderate effects. The desilting pond water and the fine refuse slurry were evaluated by the Rodent Acute In Vivo test and both produced low or nondetectable toxic effects. All of the five

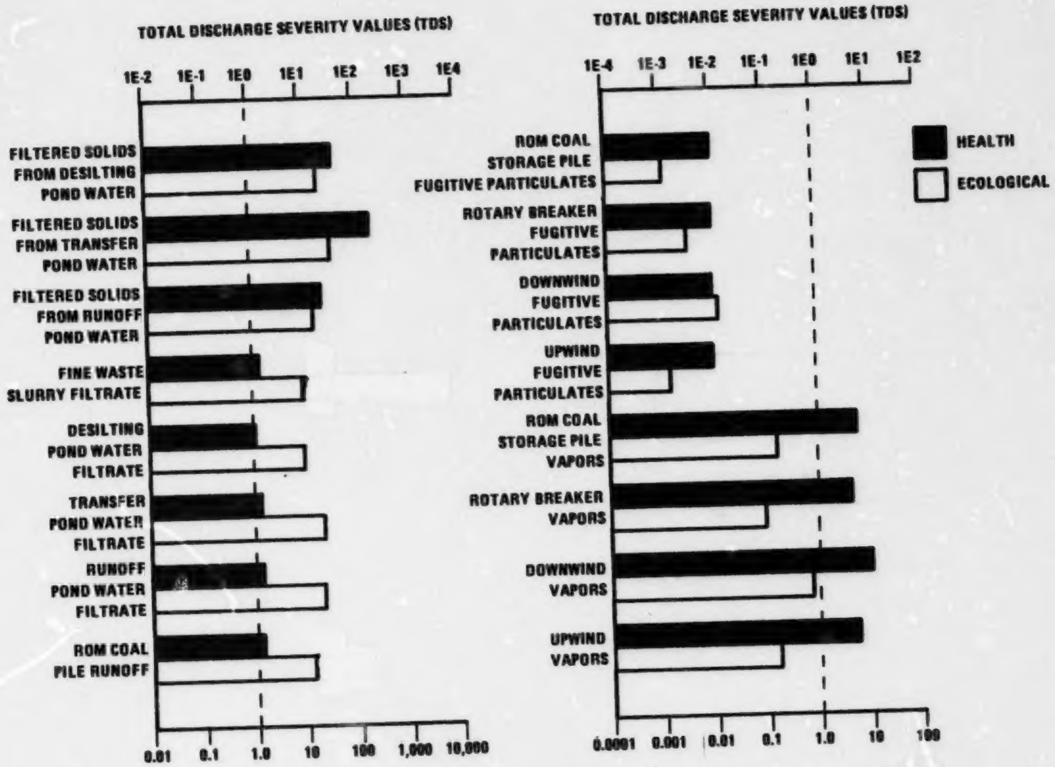


FIGURE 1-2. TOTAL DISCHARGE SEVERITY VALUES FOR ALL SAMPLE WASTE STREAMS FOR COAL PREPARATION PLANT NO. 2

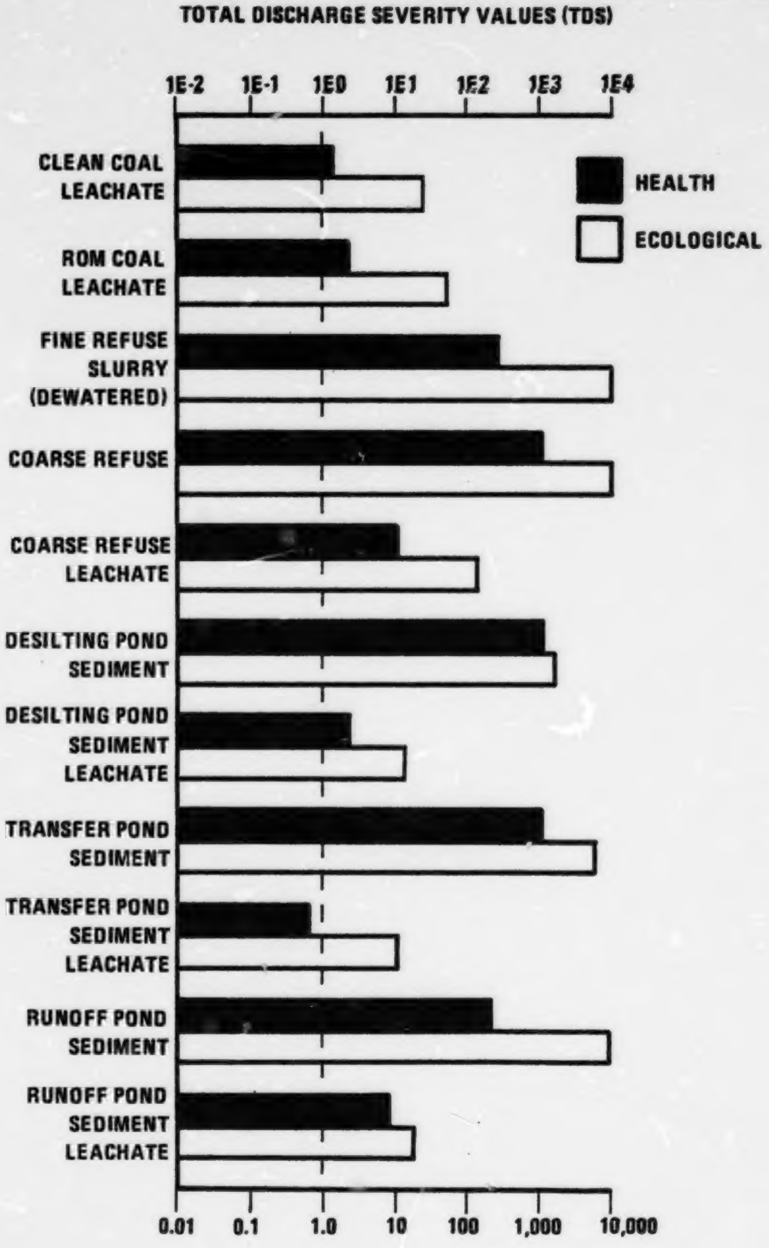


FIGURE 1-2. TOTAL DISCHARGE SEVERITY VALUES FOR ALL SAMPLE WASTE STREAMS FOR COAL PREPARATION PLANT NO. 2 (CONTINUED)

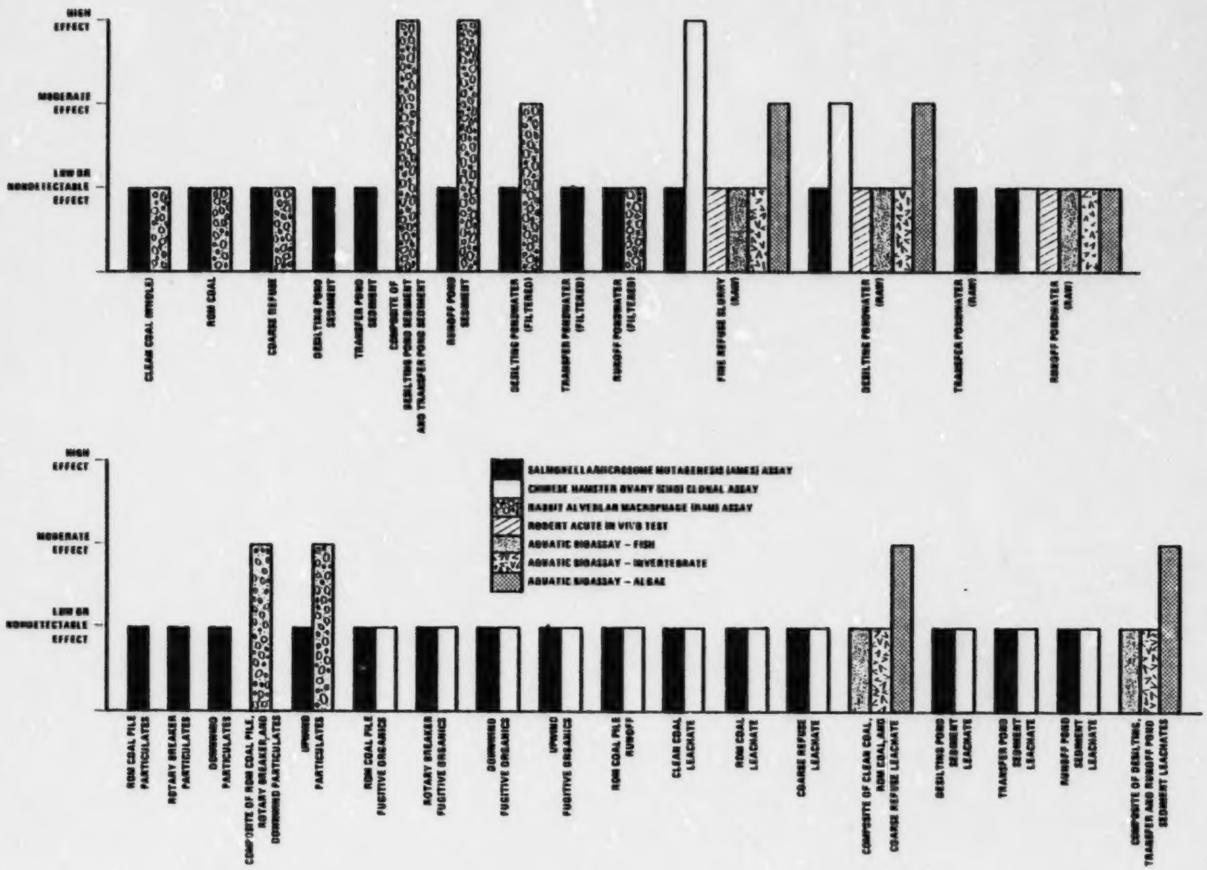


FIGURE 1-3. RESULTS OF HEALTH AND ECOLOGICAL EFFECTS TESTS FOR MATERIALS ASSOCIATED WITH COAL PREPARATION PLANT NO. 2

samples evaluated by the aquatic bioassays with fish and invertebrates were found to be nontoxic. The same five samples were evaluated by aquatic bioassays with an alga and were found to produce moderate effects.

A summary of the multimedia chemical and biological stream characteristics and control strategy recommendations is provided in Table 1-2.

1.4.2 Fugitive Particulates and Vapors

Fugitive particulate and vapors were sampled downwind of coal handling areas and storage piles, and upwind and downwind of plant operations. The fugitive samples had relatively low total suspended particulate (TSP), total organic concentration, and total discharge severity (TDS) values. The TSP values were highest around the ROM coal storage pile and the rotary breaker as expected because of continuous coal handling activities. The hydrocarbon concentrations were highest upwind and downwind of the coal preparation facility, most likely because of coal handling and diesel truck activities. To determine the contribution of the plant to ambient air concentrations, upwind values were subtracted from downwind concentrations. The resulting downwind contribution was 70 $\mu g/m^3$ for total suspended particulates (compared to the 24-hour primary and secondary ambient air quality standards for TSP of 260 $\mu g/m^3$ and 150 $\mu g/m^3$, respectively) and 40 $\mu g/m^3$ for extractable organics. Particulate morphology tests showed that downwind particulates were primarily quartz-like material rather than coal particles. However, downwind particulates show a slightly higher concentration of coal dust than the upwind sample. Therefore, it is recommended that better dust suppression controls around coal handling areas could alleviate some of the TSP loading. The fugitive particulate sample results show a low potential for hazard according to the low TDS values; however, the results show a potential hazard based on health-related bioassay test results (RAM tests results showed moderate effects).

1.4.3 Liquid Waste Streams

Liquid waste streams included fine refuse slurry, desilting, transfer and runoff pond waters, and ROM coal pile runoff. Only filtered samples

TABLE 1-2. SUMMARY OF ENVIRONMENTAL RESULTS

Waste Stream	Total Discharge Severity		Major Contributors (Discharge Severity >10)		Biological Results		Conclusions	Recommendations
	Health	Ecological	Health	Ecological	Health	Ecological		
ROM Coal Storage Pile Fugitive Particulates	1.3E-2	2.0E-3	-	-	M	N.C.	• Low potential for hazard according to TDS values; however, potentially hazardous based on health-related bioassay test results. • Particulate morphology shows coal in all but upwind samples. • TSP values for fugitives below primary standard, except rotary breaker.	• Improve techniques for control of fugitive emissions.
Rotary Breaker Fugitive Particulates	1.1E-2	6.0E-3	-	-	M	N.C.		
Upwind Fugitive Particulates	1.2E-2	2.0E-2	-	-	M	N.C.		
Downwind Fugitive Particulates	1.1E-2	3.0E-3	-	-	M	N.C.		
ROM Coal Storage Pile Vapors	7.9E0	3.0E-1	-	-	L/N	N.C.	• Low potential for hazard according to TDS values and bioassay test results.	
Rotary Breaker Vapors	6.7E0	1.0E-1	-	-	L/N	N.C.		
Upwind Vapors	7.7E0	3.1E-1	-	-	L/N	N.C.		
Downwind Vapors	1.2E1	9.0E-1	-	-	L/N	N.C.		
Fine Waste Slurry Filtrate (bio. tests conducted on raw slurry)	2.0E0	1.0E1	-	-	H	M	• Uncertain potential hazard according to ecological-based SAM/1A evaluation. Potentially hazardous based upon bioassay test results.	• Should not discharge directly to offsite surface waters; should be treated onsite.
Desilting Pond Water Filtrate (bio. tests conducted on raw pond water)	1.4E0	8.0E0	-	-	M	M		

TABLE 1-2. SUMMARY OF ENVIRONMENTAL RESULTS (Continued)

Waste Stream	Total Discharge Severity		Major Contributors (Discharge Severity >10)		Biological Results		Conclusions	Recommendations
	Health	Ecological	Health	Ecological	Health	Ecological		
Transfer Pond Water Filtrate (bio. tests conducted on raw pond water)	1.4E0	1.5E1	-	-	L/N	N.C.	• Low potential for hazard according to health-based criteria. • Uncertain hazard potential according to ecological TDS values.	• Should not discharge directly to offsite surface waters; should be treated onsite.
Runoff Pond Water Filtrate (bio. tests conducted on raw pond water).	2.6E0	1.8E1	-	-	L/N			
ROM Coal Storage Pile Runoff	2.0E0	1.6E1	-	-	L/N	N.C.	• Low potential for hazard according to health-based criteria. • Uncertain hazard potential according to ecological TDS values.	• Collect runoff for treatment.
Clean Coal Leachate	2.2E0	3.5E1	-	NH_3-N	L/N	M	• Uncertain hazard potential according to ecological-based criteria. • Chemical constituents are more leachable in the coarse refuse than other solids. • Coarse refuse already stored in closed system.	• Use RCRA's EP Method for leachability to investigate leaching potential under acid conditions. • Should not discharge pond waters directly to offsite surface waters. • If discharged, treat for trace metals control. • Check origin of nitrogen compound in samples.
ROM Coal Leachate	4.0E0	6.7E1	-	NH_3-N	L/N	M		
Coarse Refuse Leachate	1.0E1	2.0E-2	-	NH_3N,Mn,Ni	L/N	M		
Desilting Pond Sediment Leachate	4.1E0	2.0E1	-	-	L/N	M		
Transfer Pond Sediment Leachate	8.4E-1	1.2E1	-	-	L/N	M		
Runoff Pond Sediment Leachate	9.2E0	3.3E1	-	Mn	L/N	M		
Desilting Pond Water Filtered Solids	6.5E1	4.1E1	Mn,Hg	P	M	N.C.	• Uncertain hazard potential according to SAM/1A evaluation and health-based bioassay test results.	• Retain material orsite via sedimentation. • Check forms of phosphorus.

TABLE 1-2. SUMMARY OF ENVIRONMENTAL RESULTS (Continued)

Waste Stream	Total Discharge Severity		Major Contributors (Discharge Severity >10)		Biological Results		Conclusions	Recommendations
	Health	Ecological	Health	Ecological	Health	Ecological		
Transfer Pond Water Filtered Solids	4.1E2	6.1E1	Hg	P	L/N	N.C.	• Moderate potential for hazard based on SAM/1A evaluation. No or low hazard based on health-related bioassay test results.	• Retain material onsite via sedimentation. • Check forms of phosphorus.
Runoff Pond Water Filtered Solids	4.2E1	3.1E1	Mn,Hg	P	L/N	N.C.		
Desilting Pond Sediment	1.6E3	3.1E3	Mn,Ba,As, Cr,Pb,Li, Ni,P,V	P,Mn,V	H	N.C.	• High potential for hazard based on SAM/1A evaluation and health-related bioassay test results.	• Retain material onsite. • Check forms of phosphorus. • Further characterization during level 2 testing.
Transfer Pond Sediment	1.2E3	8.1E3	Cr,Mn,As, Ba,Cd,Pb, Li,Ni,P,V	P,Mn	H	N.C.		
Runoff Pond Sediment	4.3E2	1.0E4	Ba,As,Cd, Pb,Li,Ni, P,V	P,Cd,Ni	H	N.C.		
Coarse Refuse	2.1E3	1.0E4	Mn,Pb,Se, As,Ba,Cd, Cr,Li,Ni, P,V	P,Pb,Mn	L/N	N.C.	• High potential for hazard based on SAM/1A evaluation. Low or no hazard based on health-related bioassay results.	• Store coarse refuse in a closed system. • Check forms of phosphorus.

N.C. = Not conducted
L/N = Low or nondetectable effect
M = Moderate effect
H = High effect

were analyzed for trace element concentration. The health-based TDS values for trace elements were low with a range of 1.4 to 2.6. The TDS values for the ecological-based analyses were much greater, ranging from 110 to 1,000. The major contributors to the high ecological TDS values were manganese and nickel. When compared to the most stringent effluent regulations for states in the Eastern Midwest and Northern Appalachian coal regions, the pond waters and runoff sample complied with every regulation.

The total extractable organic concentrations ranged from <200 μg/ℓ to 400 μg/ℓ. The highest organic values were measured in the transfer pond water. The organic concentrations were low and there was no detectable concentrations of chromatographable organics in any liquid waste stream (i.e., TCO < 100 μg/ℓ).

Biological effects tests were performed on unfiltered pond water samples. All liquid waste streams with the exception of the desilting pond water and the fine refuse slurry produced negative or nondetectable cellular and toxic responses. The desilting pond water sample produced a moderate effect [i.e., median effective concentration (EC_{50}) of 255 μl/ml] when evaluated by the CHO clonal assay and a moderate effect on the aquatic bioassay with algae. The fine refuse slurry produced a high cellular effect (EC_{50} is 3.3 μl/ml) when evaluated by CHO clonal assay and a moderate effect on the aquatic bioassay with algae.

The data indicate a need for treatment of the pond water and ROM coal pile runoff if discharged directly to offsite surface waters. Currently, the pond waters at this preparation plant are not discharged. Also, the plant collects all storm water runoff from the surrounding areas of the plant property, including the storage pile and haul roads, into a series of diversion ditches that run into the runoff pond. The runoff pond is designed not to discharge except under the conditions of a ten-year, 24-hour heavy rainfall event.

1.4.4 Solids and Leachates

Solid samples analyzed include ROM and clean coal, coarse refuse, fine refuse, pond sediments, and filtered pond solids. A leachate was generated from each solid sample except filtered pond solids. The health-based, trace element TDS values for solids ranged from 42 to 2,100, with the highest values obtained from the coarse refuse and desilting pond sediment. The high TDS values are an indication of the presence of fine coal and ash particles. In contrast, the highest health-based TDS value for solid leachates is nine.

The ecological-based, trace element TDS values for solids ranged from about 31 to 10,000. The lowest TDS values were obtained from the filtered solids from the pond waters. The pond sediments, coarse refuse, and fine refuse had the highest values and in all cases the major contributor was phosphorus. The leachates produced ecological TDS values of about the same magnitude with values ranging from 1,600 to 1,800. Ammonia and manganese were significant contributors.

Total extractable organics in solids were only measured for pond sediments. The TCO + Grav concentration for the three pond sediments is <20 μg/g. The ROM coal, clean coal, coarse refuse, and pond sediment leachates had TCO + Grav values below the detection limit of 1,000 μg/ℓ. The low organic concentrations indicate little or no organic material is being leached from the coal by washing.

Biological assessments for solids showed high effects from the composite of desilting pond and transfer pond sediments, and from the runoff pond sediments when evaluated by the RAM assay. The filtered solids from the desilting pond water also produced moderate effects when evaluated by the RAM assay. The other ten solid sample bioassays had low or nondetectable effects. For leachates, all health-based bioassays showed low or nondetectable effects. However, both the composite of ROM coal, clean coal, and coarse refuse leachates, and the pond sediment leachates composite had moderate effects on the aquatic bioassay with algae. The composite samples produced nondetectable effects on fish and invertebrates. The moderate effects on the algae could have been due to high phosphate and nitrogen concentrations.

1.5 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1.5.1 Fugitive Emissions

Based upon the results from plant No. 2, there does not appear to be a fugitive dust problem at the plant boundaries. The results from this plant do not support the need for further study of fugitive air emissions during the Level 2 environmental assessment phase.

1.5.2 Liquid Waste Streams

Manganese, and nickel also had a discharge severity values greater than one in most liquid streams. The presence of these metals in the liquid waste streams is not unexpected as they are found in the coal. They are not produced by the preparation process. These results support the need for further characterization of liquid streams during the Level 2 environmental assessment phase.

1.5.3 Solids and Leachate Waste Streams

As expected, the pond sediments and fine waste solids contained heavy metals and other elements at concentrations that produce discharge severities ranging up to 10,000. These elements originate in the coal and the cleaning process is intended to produce refuse by removing incombustibles from the coal. The high concentrations of the elements emphasize the concern over their ultimate disposal and that precautions must be taken to prevent the migration of these chemicals to the ground water.

In all leachate waste streams, ammonia had a discharge severity value greater than one, on either a health or ecological basis. Since no previous studies have identified high ammonia concentrations, it is recommended that the protocol for analyzing ammonia include the use of standards for verification to determine if the ammonia is a result of interference during analysis or if the origin of ammonia results from coal mining activities.

The leachates from the ROM coal and clean coal show a potential for problems based on ecological effects and considerably smaller potential for problems based on health effects.

The coarse refuse leachate, the pond sediment leachates, and the pond waters show a higher potential for problems based on the ecological DMEG values and bioassay results. The sediment leachate chemical concentrations are only slightly higher than the pond water filtrates, which are in contact with the sediment. This is probably due to the high pH of the pond water and dilution of the pond water by plant influent and precipitation. It is recommended that the Extraction Procedure Method for testing leachability described in RCRA regulations be used in conjunction with the ASTM Method in future Level 1 and 2 environmental assessments to investigate the leaching potential under acidic conditions. It is also recommended that the pond sediments be further characterized during Level 2 testing.

SECTION 2.0

COAL CLEANING PLANT AND AREA DESCRIPTION

2.1 SURROUNDING AREA AND ENVIRONMENT

Coal preparation plant No. 2 is located in Illinois in a glaciated area of low relief. The area has wide valleys and a well-developed drainage system that is part of the Saline River watershed.

The climate in this area is the humid continental type. The average January temperature is 2°C and the average July temperature is 26°C. The average annual rainfall is 114 cm and the average annual snowfall is 35 cm.

Approximately 55 percent of the land in the county is used for agriculture. Livestock raising and mining are also significant land uses. The soils in the area are predominantly silt loams derived from glacial deposits. They are generally well drained on upland areas, but poorly drained where the topography is nearly level.

Pleistocene glaciation left a relatively thin layer of unsorted glacial till over the northern part of the county. The glacial deposits cover Pennsylvanian-age sedimentary rocks that are mostly sandstones and shales with minor amounts of interbedded limestone and coal (Table 2-1). The area is within the southern part of a structural basin centered in Illinois; thus, bedrock dips gently to the north and northwest. The Cottage Grove fault system, trending east-west, is located about 2.6 km north of the plant. Because the glacial drift is thin, topography in the region is generally controlled by bedrock.

Ground-water availability in the region is limited. The principal source of water in the area is from surface supplies. Most wells are shallow and are drilled into glacial till or terrace deposits along major drainage ways. These wells and cisterns supply small but usable quantities of water.

TABLE 2-1. STRATIGRAPHIC SECTION FOR COAL PREPARATION PLANT NO. 2 AREA

SYSTEM	SERIES	GROUP	FORMATION
QUARTERNARY	PLEISTOCENE		ALLUVIUM + LOESS
	UPPER		HENSHAW (SANDSTONES/ SHALES)
			LISMAN (LIMESTONE/ SANDSTONE)
PENNSYLVANIAN	MIDDLE		CARBONDALE (SANDSTONE)
			TRADEWATER (LIMESTONE/ SANDSTONE)
	LOWER		CASEYVILLE (SANDSTONE)

Bedrock aquifers, however, are not very productive and rarely yield more than about 1 to 5 ℓ/sec, except for small lenses of sandstone interbedded with the limestone and shale. Fractured rocks in the vicinity of the fault zone may yield slightly greater amounts of water.

2.2 COAL CLEANING PLANT DESCRIPTION

A flow chart of the cleaning plant is provided as Figure 2-1. The plant capacity is rated at 1,088 kkg per hour (i.e., 1,200 tph). The plant processes coal from two strip mines working the Illinois No. 6 seam. Coal is extracted from the surface mine by dragline operations and hauled from the strip mine to the preparation plant by trucks. The coal trucks unload the run-of-mine coal on top of the raw coal storage pile. It is then transferred to the plant feed belt by a bulldozer transfer into an ROM coal hopper.

Raw coal feed to the plant is screened over a stationary primary screen. Everything above five inches is sent to the rotary breaker, and the underflow from the screen is blended with the product from the rotary breaker and placed on the incoming raw coal distribution belt. The 5 x 0 in. coal is then fed to a two-stage Baum Jig for primary washing. The clean coal from the Baum Jig is dewatered on a 3/16 in. stationary screen, and the overflow goes through a double-deck washed coal screen. The product of the top screen is 5 x 1-1/4 in. clean coal. The clean coal is fed to a crusher to produce a top size of 1-1/2 in. and then fed onto the clean coal load-out belt. The overflow from the bottom screen (1-1/2 x 3/8 in. coal) is dewatered in centrifuges and loaded onto the clean coal belt. The underflow from the washed coal screens, which is predominantly 3/8 in. by 0 material, goes to the washed coal sumps.

The middlings product from the two-stage Baum Jig is sent to a middling screen for size separation. The overflow in the middling screen is fed to a crusher that reduces the material to one inch top size and then blends it back into the feed to the Baum Jig. The underflow in the middling screen, which is 1/2 in. x 0 coal, is then routed to the fine coal refuse slurry sump. The rejects from the two-stage Baum Jig are dewatered on a refuse screen and sent to a refuse bin container for load-out by truck. The under-

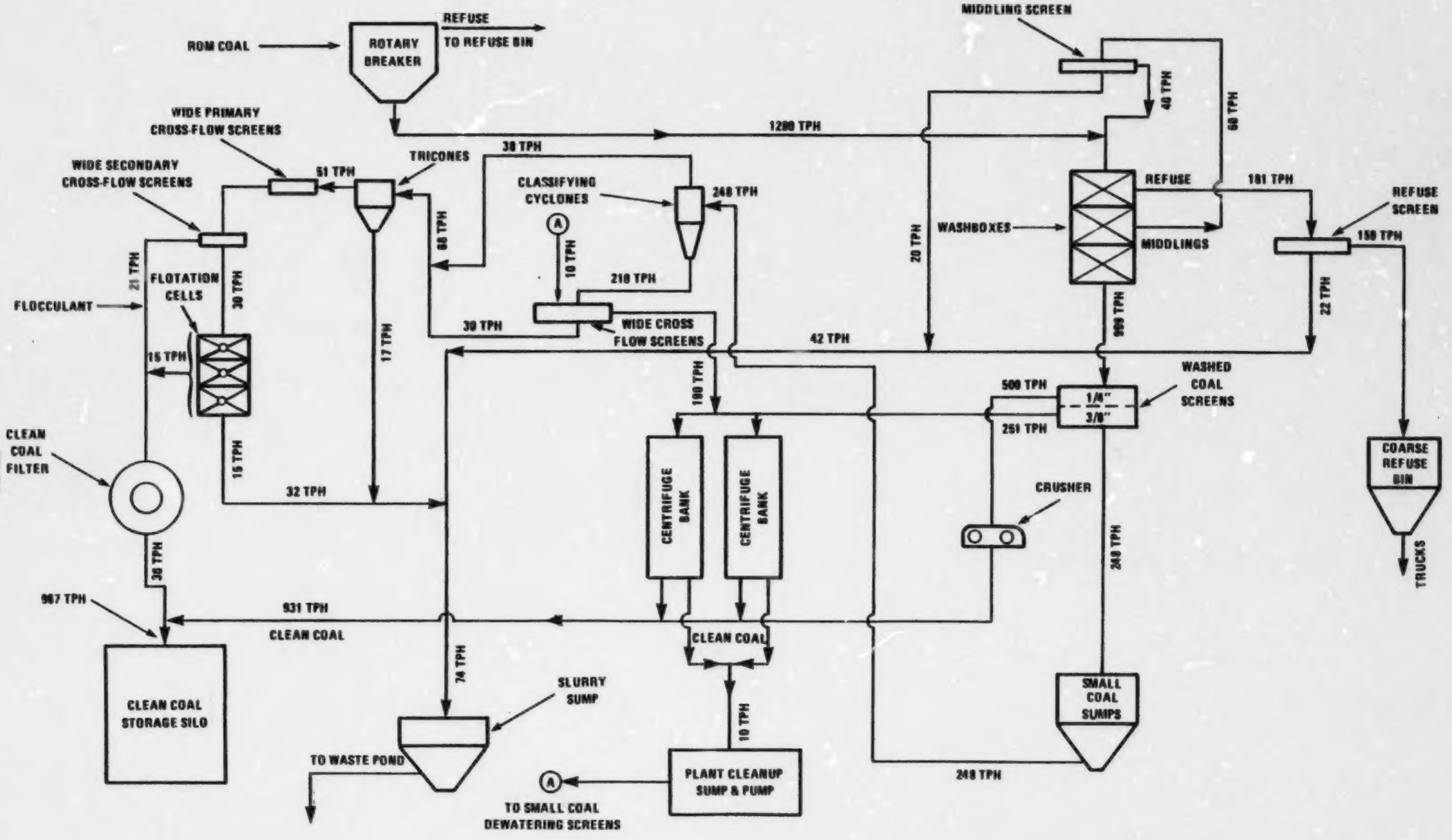

ROM COAL
ROTARY BREAKER
REFUSE
TO REFUSE BIN
1280 TPH
WIDE PRIMARY CROSS-FLOW SCREENS
WIDE SECONDARY CROSS-FLOW SCREENS
51 TPH
TRICONES
38 TPH
68 TPH
CLASSIFYING CYCLONES
248 TPH
A
10 TPH
210 TPH
30 TPH
WIDE CROSS FLOW SCREENS
21 TPH
FLOTATION CELLS
30 TPH
FLOCCULANT
15 TPH
17 TPH
15 TPH
32 TPH
CLEAN COAL FILTER
36 TPH
967 TPH
931 TPH
CLEAN COAL
CLEAN COAL STORAGE SILO
74 TPH
SLURRY SUMP
TO WASTE POND
190 TPH
CENTRIFUGE BANK
CENTRIFUGE BANK
CLEAN COAL
10 TPH
PLANT CLEANUP SUMP & PUMP
A
TO SMALL COAL DEWATERING SCREENS
MIDDLING SCREEN
40 TPH
60 TPH
20 TPH
WASHBOXES
REFUSE
MIDDLINGS
181 TPH
REFUSE SCREEN
159 TPH
22 TPH
42 TPH
999 TPH
WASHED COAL SCREENS
500 TPH
1/4"
3/8"
251 TPH
CRUSHER
248 TPH
SMALL COAL SUMPS
248 TPH
COARSE REFUSE BIN
TRUCKS

FIGURE 2-1. FLOW CHART FOR COAL PREPARATION PLANT NO. 2.

flow from the coarse refuse screens is combined with other fine coal refuse products of the plant and sent to the fine coal slurry sump.

The intermediate size material consists of 3/8 in. x 0 coal coming from the underflow of the double-deck clean coal wash screen. This coal is collected in sumps and pumped to a set of eight 24-inch diameter classifying cyclones. The deslimed fine coal material is dewatered and sent to the mechanical dewatering system consisting of eight centrifuges. The underflow from the clean coal dewatering screens is collected in a sump and the slurry material consisting of 28 mesh x 0 coal is pumped to a set of 12-inch cyclones for further cleaning. The overflow from the 12-inch cyclones is fed to two banks of flotation cells for final cleaning. The fine clean coal is sent to a disc filter to be dewatered and loaded on a clean coal delivery belt. The underflow from the 12-inch diameter cyclones is combined with fine refuse material from the flotation cells and piped to the fine coal refuse slurry sump.

The refuse streams in the plant consist of:

- Coarse refuse from the Baum Jig which is dewatered on screens and sent to the coarse refuse hopper.
- Fine refuse collected in a sump from the underflow of the polishing cyclones, froth flotation cells, and Baum Jig.

The fine refuse slurry collected in the fine coal sump is pumped to a desilting pond. The pond water overflows into a transfer pond from which water is recycled for make-up in the plant.

2.3 AUXILIARY FACILITIES

As shown in Figure 2-2, the auxiliary facilities consist of: the run-of-mine storage pile for the Illinois No. 6 coal; a 13.6×10^3 kkg (15,000 t) capacity washed coal storage silo with unit train loading facility that includes an automatic sampling system; a large fine coal refuse pond with provisions for recycling water from a transfer pond to the plant; a 360 kkg (400 t) capacity refuse bin; and a large storm water runoff pond. The plant disposes of coarse refuse material offsite; therefore, there is no coarse refuse pile.

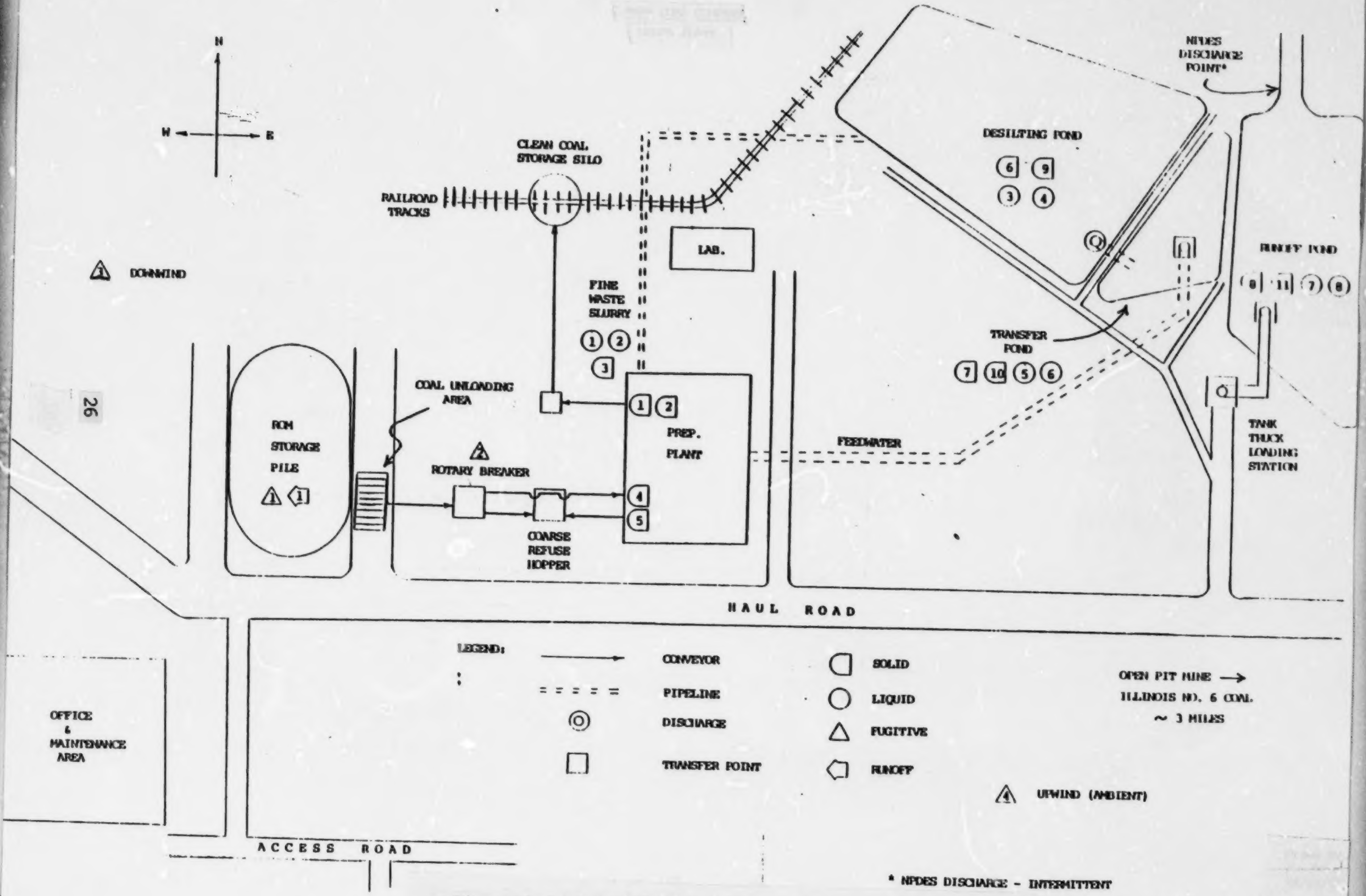

N
W
E
DOWNWIND
CLEAN COAL STORAGE SILO
RAILROAD TRACKS
LAB.
FINE WASTE SLURRY
① ② 3
COAL UNLOADING AREA
ROM STORAGE PILE
1
2
ROTARY BREAKER
COARSE REFUSE HOPPER
PREP. PLANT
1 2
4
5
FEEDWATER
DESILTING POND
6 9
③ ④
TRANSFER POND
7 10 ⑤ ⑥
RUNOFF POND
8 11 ⑦ ⑧
NPDES DISCHARGE POINT*
TANK TRUCK LOADING STATION
HAUL ROAD
ACCESS ROAD
OFFICE & MAINTENANCE AREA
LEGEND:
CONVEYOR
PIPELINE
DISCHARGE
TRANSFER POINT
SOLID
LIQUID
FUGITIVE
RUNOFF
4
UPWIND (AMBIENT)
OPEN PIT MINE →
ILLINOIS NO. 6 COAL
~ 3 MILES
* NPDES DISCHARGE - INTERMITTENT

Figure 2-2. Plot plan for coal preparation plant No. 2.

2.3.1 ROM Storage Facilities

Coal preparation plant No. 2 is supplied with Illinois No. 6 coal from two strip mines in the area. The coal is transported to the cleaning plant by large coal trucks using a major haul road running alongside the plant. At the plant the coal is dumped on the raw coal storage pile where it is transferred to the hopper by a bulldozer. From the raw coal hopper a stacker reclaimer system conveys the coal to a rotary breaker and then on to subsequent transfer to the preparation plant on a conveyor belt. The conveyor facilities are all covered to prevent escape of fugitive dust.

2.3.2 Clean Coal Storage and Sampling System

Clean coal is conveyed from the preparation plant through a series of conveyors to a 13,600 kkg capacity storage silo located approximately 700 m from the plant. The storage facility is completely self-contained and none of the clean coal is exposed to the environment. The storage silo feeds a rail train loading system and is situated over the top of the railroad track. In conjunction with the clean coal conveyor belt, there is an automatic sampling system that provides ASTM samples of the product coal. This sampling equipment was used for taking representative samples of clean coal during the environmental assessment activities.

2.3.3 Fine Coal Refuse Settling Pond

Coal preparation plant No. 2 uses a large fine coal refuse pond (i.e., blackwater pond) to clarify the fine refuse slurry water and to maintain a closed water system. There is no point source discharge from this pond.

The slurry refuse pond receives fine coal slurry directly from the waste sump located in the main coal preparation building. The slurry pipeline is located underground until it reaches the slurry pond. The pond is located approximately 1,500 m away from the preparation plant. The coal refuse slurry is introduced into one area of the pond and clarified water is removed from the opposite end of the pond. The clarified water is stored in a transfer pond from which it is pumped back into the plant on demand for feed water.

2.3.4 Storm Water Runoff Pond

The plant collects all storm water runoff from the surrounding areas of the plant property, including the storage piles and haul roads, into a central series of diversion ditches that run into a large runoff pond. The pond was designed not to discharge except under the conditions of a 10-year, 24-hour heavy rainfall event. There is an NPDES permit at a discharge point, but there are no data available on the quality of the storm water runoff from the plant.

2.3.5 Coarse Refuse Bin

Coarse refuse material is conveyed from the preparation plant through the top of a 360 kkg (400 t) capacity refuse bin approximately 50 m away from the plant. The coarse refuse hopper is situated off the ground to provide clearance for haul trucks to collect the coarse refuse from the bin. Haul trucks receive the coarse refuse from the bin and convey it back to the strip pits for disposal.

SECTION 3.0

SAMPLING METHODOLOGY

Twenty-five process and waste streams were sampled during the second coal preparation plant test program. Descriptions of each sampling point and the sampling methods employed are presented in this section.

3.1 FUGITIVE EMISSIONS (PARTICULATE AND VAPOR)

3.1.1 Sampling Point Locations

Fugitive emissions were sampled at the following locations:

- Downwind of ROM coal pile.
- Downwind of rotary breaker.
- Downwind of plant facility.
- Upwind of the site.

Figure 3-1 indicates the approximate locations of the fugitive sampling sites represented by the triangles on the sketch. The particulates and vapor samples collected at these locations were analyzed for the chemical and biological parameters as indicated by their respective code numbers in parts 3 and 4 of Table 3-1.

Fugitive emissions are best sampled downwind of their source at a location where settleable particulates are calculated to have been carried near ground level. Therefore, chosen sampling locations were dependent on such variables as wind velocity, wind direction, and physical dimensions of the source itself. Overall site emissions were sampled using the upwind/downwind technique. This technique utilizes samplers to determine the background concentrations (including the background and any point source contributions) upwind of the site. The total fugitive emissions from the site are then calculated by subtracting the measured background and point

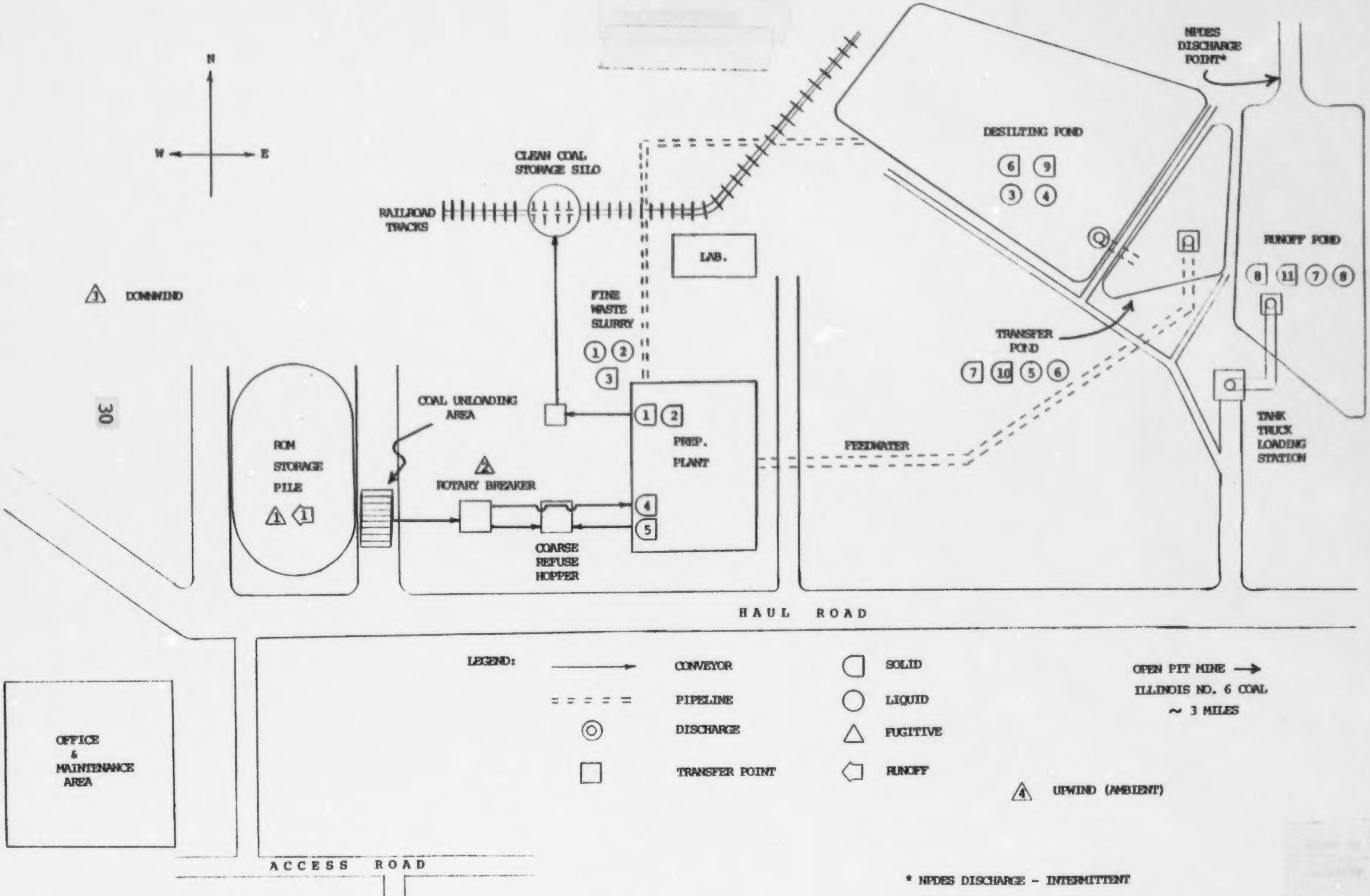

N
W
E
DOWNWIND
RAILROAD TRACKS
CLEAN COAL STORAGE SILO
LAB.
FINE WASTE SLURRY
1 2 3
DESILTING POND
6 9 3 4
NPDES DISCHARGE POINT*
RUNOFF POND
8 11 7 8
TRANSFER POND
7 10 5 6
TANK TRUCK LOADING STATION
COAL UNLOADING AREA
ROM STORAGE PILE
1 1
2
ROTARY BREAKER
COARSE REFUSE HOPPER
PREP. PLANT
1 2 4 5
FEEDWATER
HAUL ROAD
OFFICE & MAINTENANCE AREA
ACCESS ROAD
LEGEND:
CONVEYOR
PIPELINE
DISCHARGE
TRANSFER POINT
SOLID
LIQUID
FUGITIVE
RUNOFF
4 UPWIND (AMBIENT)
OPEN PIT MINE →
ILLINOIS NO. 6 COAL
~ 3 MILES
* NPDES DISCHARGE - INTERMITTENT

Figure 3-1. Sampling sites for coal preparation plant No. 2.

TABLE 3-1. OVERALL LEVEL 1 SAMPLING AND ANALYSIS PLAN FOR COAL CLEANING PLANT NO. 2

	SAMPLE CODE	ELEMENTAL (SSMS)	Hg (AAS)	COAL	WATER QUALITY (including anions)	PARTICULATE MORPHOLOGY	ORGANICS	MUTAGENESIS (AMES)	CYTOTOXICITY (RAM)	CYTOTOXICITY (CHO)	RODENT ACUTE TOXICITY	AQUATIC BIOASSAY	RADIATION	ADDITIONAL SAMPLES
	← PARAMETER CODES →													
I. SOLIDS														
1. CLEAN COAL - WHOLE	101	01	02	03				17	18				23	
2. CLEAN COAL - CRUSHED	102	01	02	03									23	
3. FINE REFUSE (DEWATERED)	103	01	02	03										
4. ROM COAL	104	01	02	03				17	18				23	
5. COARSE REFUSE	105	01	02	03				17	18				23	
6. DESILTING POND SEDIMENT	106	01	02				15	17	18				23	
7. TRANSFER POND SEDIMENT	107	01	02				15	17	18				23	
8. RUNOFF POND SEDIMENT	108	01	02				15	17	18				23	
9. DESILTING PONDWATER (FILTERED)	109	01	02					17	18					
10. TRANSFER PONDWATER (FILTERED)	110	01	02					17	18					
11. RUNOFF PONDWATER (FILTERED)	111	01	02					17	18					
II. LIQUIDS														
1. FINE REFUSE SLURRY - RAW	121							17		19	20	21	23	
2. FINE REFUSE SLURRY - FILTRATE	122	01	02		04,05 07		16							
3. DESILTING PONDWATER - RAW	123							17		19	20	21	23	
4. DESILTING PONDWATER - FILTRATE	124	01	02		04,05 07		16							
5. TRANSFER PONDWATER - RAW	125							17					23	
6. TRANSFER PONDWATER - FILTRATE	126	01	02		04,05 07		16							
7. RUNOFF PONDWATER - RAW	127							17		19	20	21	23	
8. RUNOFF PONDWATER - FILTRATE	128	01	02		04,05 07		16							
III. FUGITIVE DUSTS														
1. ROM COAL STORAGE PILE	141	01	02			09-14		17	18				09-14	
2. ROTARY BREAKER	142	01	02			09-14		17	18				09-14	
3. DOWNWIND - ENTIRE FACILITY	143	01	02			09-14		17	18				09-14	
4. UPWIND - AMBIENT BLANK	144	01	02			09-14		17	18				09-14	
IV. FUGITIVE ORGANIC VAPORS (XAD-2)														
1. ROM COAL STORAGE PILE	151	01	02				15	17	18					
2. ROTARY BREAKER	152	01	02				15	17	18					
3. DOWNWIND	153	01	02				15	17	18					
4. UPWIND	154	01	02				15	17	18					
V. RUNOFF														
1. ROM COAL PILE	161	01	02		04,05 07		16	17		19			23	
VI. LEACHATE														
1. CLEAN COAL	171	01	02		06,07 08		15	17		19		21		
2. ROM COAL	172	01	02		06,07 08		15	17		19		21		
3. COARSE REFUSE	173	01	02		06,07 08		15	17		19		21		
4. DESILTING POND SEDIMENT	174	01	02		06,07 08		15	17		19		21		
5. TRANSFER POND SEDIMENT	175	01	02		06,07 08		15	17		19		21		
6. RUNOFF POND SEDIMENT	176	01	02		06,07 08		15	17		19		21		

} INDICATE ANALYSIS OF COMPOSITE SAMPLE

(continued)

TABLE 3-1. (continued)

NOTES

All samples will be coded using the following scheme:

Sample Code - Parameter Code
(three digit) (two digit)

Multiple analyses which will be conducted on a sample from one container may be coded together (e.g., 101-19,20).

PARAMETER CODE	PARAMETER	LABORATORY
01	Elemental (SSMS)	CTE
02	Mercury (AAS)	Versar
03	Coal (Ultimate & Proximate)	CTE
04	Water Quality Test A - pH, Cond., Temp., D.O., Hard., Alk., Acidity, NH_3-N, NO_3^--N, NO_2^-, CN^-, PO_4-P, $SO_3^=$, $SO_4^=$, F^-, Cl^-, Cl_2, S^-	Versar (field)
05	Water Quality Test B - BOD, TSS	Versar
06	Water Quality Test C - BOD	Versar
07	Water Quality Test D - COD	Versar
08	Water Quality Test E - pH, Cond., Hard., Alk., Acidity, NH_3-N, NO_3^--N, NO_2^--N, CN^-, $PO_4^{\equiv}$-P, $SO_3^=$, $SO_4^=$, F^-, Cl^-, Cl_2, S^-	Versar
	Particulate Morphology & Radiation	Versar & EERF
09	- Stage 1 >7.2 microns	
10	- Stage 2 3.0-7.2 microns	
11	- Stage 3 1.5-3.0 microns	
12	- Stage 4 0.95-1.5 microns	
13	- Stage 5 <0.49-0.95 microns	
14	Final Filter 0.49 microns	
15	Organics (whole sample)	Versar
16	Organics (field extract)	Versar
17	Mutagenesis (Ames Test)	ERCO
18	Cytotoxicity (RAM)	ERCO
19	Cytotoxicity (CHO)	ERCO
20	Rodent Acute Toxicity	ERCO
21	Aquatic Bioassay (Algal, Daphnia, Fathead Minnow)	ERCO

source concentrations from the measured total pollutants. Note that this coal cleaning plant has no point source air emissions.

Measurements of predominant wind velocity and direction were made before sampling. Surface wind speed, direction, and cloud cover were used to determine the horizontal and vertical dispersion coefficients.(1) Samplers for the entire facility fugitives were located at a point no closer than 0.5 km to the nearest source. Upwind samples were collected at a point no closer than 0.3 km to the nearest cleaning plant source and away from any sources that would bias the collection of ambient particulates.

One sampler had been installed at downwind locations and sampling continued for 24 hours. A sampling rate of 1.12 m^3/min (40 ft^3/min) was used. Shifts in wind direction necessitated moving the samplers, and sampling was not conducted during periods of precipitation. Table 3-2 details the locations of each sampler, total sampling time, volume of air sampled for total particulates, and volume of air sampled for vapors.

TABLE 3-2. FUGITIVE EMISSION SAMPLING DATA

Source	Distance of Sample from Source (m)	Sampling Time (Hrs.)	Volume of Air (m^3) Sampled Particulates	 Vapor
ROM Coal Pile	100	20,000	1,359	132.0
Rotary Breaker	200	20,000	1,359	135.6
Upwind of Facility	300	20,000	1,359	116.4
Downwind of Facility	600	21,000	1,427	137.0

3.1.2 Sampling Description and Requirement

Particulate emissions and vapors were collected using two high volume (Hi-Vol) air samplers at each location (Sierra Model UV-1 flow-controlled high volume sampling system). The Hi-Vol dedicated for total particulates had an effective filter sample area of 406.5 cm^2. In addition to collecting total particulates, this sampler was modified so that vapors were collected concurrently from a side stream that passed through a cartridge containing 175 g of XAD-2 sorbent resin (see Figure 3-2). The sidestream vacuum pump

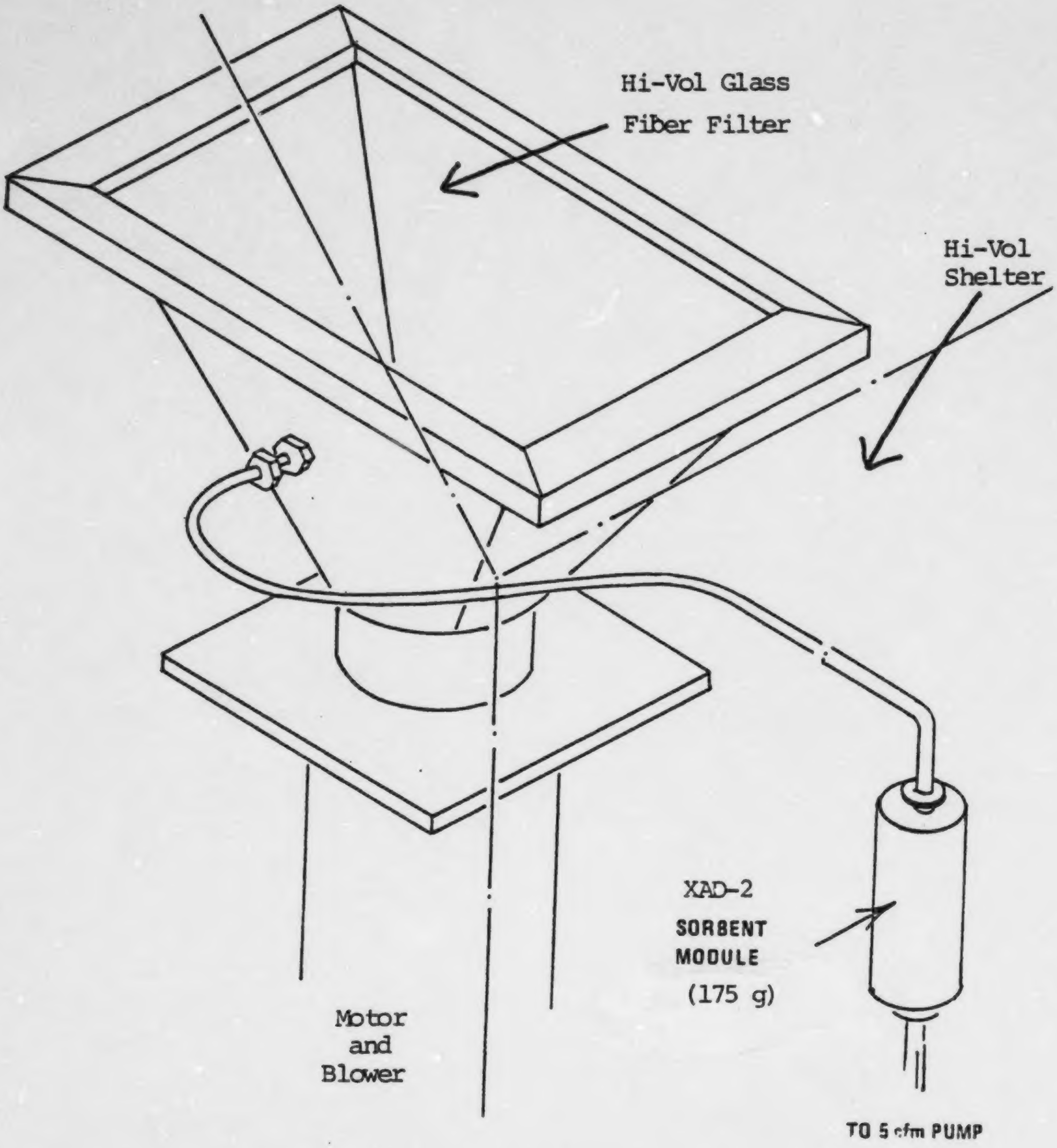

Hi-Vol Glass
Fiber Filter
Hi-Vol
Shelter
XAD-2
SORBENT
MODULE
(175 g)
Motor
and
Blower
TO 5 cfm PUMP

Figure 3-2. Modified Fugitive Emissions Sampler.

and rotometer were housed in a separate shelter placed in close proximity to the Hi-Vol.

The other Hi-Vol was positioned 15 m from the first Hi-Vol and fitted with a five-stage impactor, Sierra Model 235 (Figure 3-3).

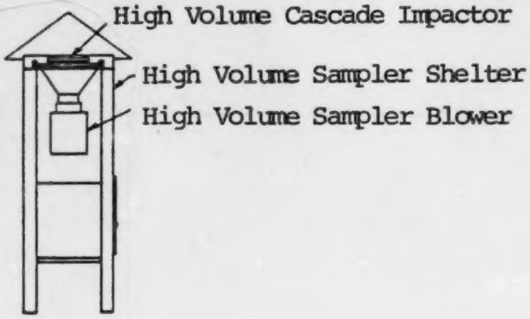

High Volume Cascade Impactor
High Volume Sampler Shelter
High Volume Sampler Blower

Figure 3-3. Hi-Vol sampler with Cascade impactor.

The Cascade impactor is based on a slotted design in which the suspended particulates enter the impactor through parallel slots in the first stage, and particles larger than the particle cutoff size of the first stage impact on the slotted collection substrate. Figure 3-4 illustrates this design.

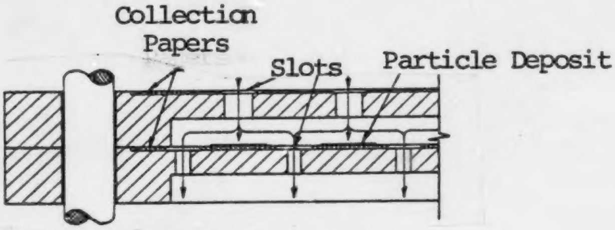


Figure 3-4. Cross-section of Cascade impactor.

The air stream then passes through the slots in the collection substrate, accelerates through narrower slots in the second impactor stage, and the remaining particles greater than the particle cutoff size of the second stage impact on the second collection substrate, etc. The width of the stage and most of the smaller particles eventually acquire sufficient momentum to impact on one of the collection substrates. After the last impactor stage, the remaining fine particles are collected by the backup filter in the high volume sampler. The collection substrates and backup filter were weighed before and after sampling to determine the particle size distribution. The particle size cutoffs in microns are given in Table 3-3.

TABLE 3-3. PARTICLE SIZE CUT POINTS FOR THE CASCADE IMPACTOR

Stage No.	Particle cutoff (microns)*
1	7.2
2	3.0
3	1.5
4	0.95
5	0.49
Backup Filter	0

* Particle size cutoffs (microns) at 1.12 m^3/min flow rate, 50 percent collection efficiency for spherical particles with unity mass density at 25°C and 760 mm Hg.

The Cascade impactor Hi-Vol samplers were fitted with Andersen Model 7000 Selective Size Inlets so that particles greater than 15 microns, generally considered not to be inhalable, would not be sampled. This greatly reduces the particle bounce problem which is a significant source of error when sampling particles of varying densities.

As shown in Figure 3-5, the ambient particulates enter the totally symmetrical, and therefore wind direction insensitive, inlet hood and are deflected upward into a buffer chamber. The spacing and slope of the inlet slit have been designed so that all particles 15 micrometers and smaller will remain entrained in the sampled air even if blown into the inlet by winds up to 20 km per hour (kph). The buffer chamber is evacuated at a rate of 68 m^3/hr (40 cfm) through nine acceleration nozzles. The particulates are accelerated to a velocity sufficient to impact those particles larger than 15 micrometers onto the impaction plate. Particulates smaller than 15 micrometers turn with the air stream and rise through the impaction chamber at velocities slow enough to minimize particle re-entrainment. The particulates then exit through the 16 vent tubes and are fractionated on the Cascade impactor.

Power was supplied to the Hi-Vol samplers and sidestream vacuum pump using a 3500 watt, gasoline-powered portable generator. The generator was positioned 50 m downwind of the samplers so that the exhaust gases would not contaminate the sample.

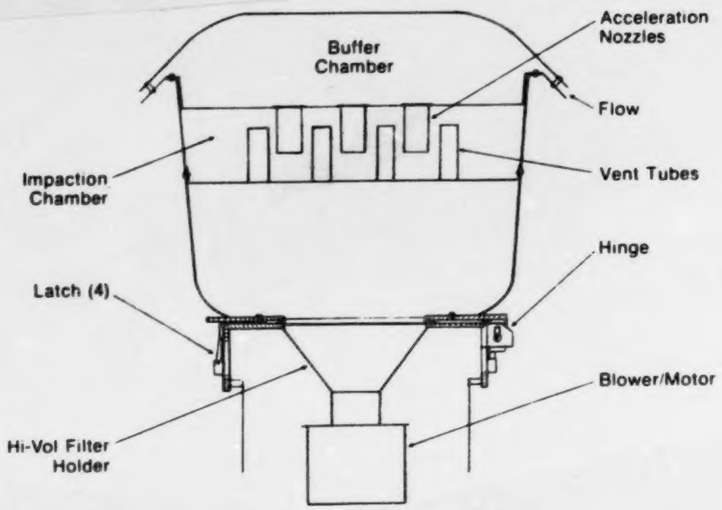

Buffer Chamber
Acceleration Nozzles
Flow
Impaction Chamber
Vent Tubes
Hinge
Latch (4)
Blower/Motor
Hi-Vol Filter Holder

Figure 3-5. Size selective inlet.

3.2 STACK EMISSIONS (PARTICULATE AND GASEOUS)

No stacks were in use at this coal preparation plant.

3.3 LIQUIDS

3.3.1 Sampling Point Location

Bulk liquids, storage pile runoff, and leachates from selected solids include the following:

- Filtrate from fine refuse slurry.
- Filtered water from the desilting pond.
- Filtered water from the transfer pond.
- Filtered water from the runoff pond.
- Runoff from the ROM coal storage pile.
- Clean coal leachate.
- ROM coal leachate.
- Coarse refuse leachate.
- Leachate from bottom sediment of desilting transfer and runoff ponds.

Figure 3-1 indicates the approximate locations where liquid samples were collected as shown by the circular symbols. The runoff sample collected around the perimeter of the raw coal storage pile is indicated by the arrow symbol. Sections 2, 5, and 6 in Table 3-1 detail the types of analyses which were conducted on these samples.

3.3.2 Sampling Description and Equipment

The volumes of aqueous liquid/slurry samples required for chemical and biological analyses are as follows:

- Organic extraction/analysis - 10 ℓ
- Health effects tests and aquatic bioassay - 42 ℓ
- Laboratory analysis - 2 ℓ
- Field analysis - 1 ℓ

The fine refuse slurry sample was collected at a point approximately 100 m north of the plant where the underground slurry pipeline discharges into a lined drainage ditch and flows to the desilting pond. The flow at this sampling point was turbulent enough to assure a well-mixed, homogeneous sample from a dipper type sampling container.

Pond water samples were collected using a diaphragm hand pump. The intake hose of the pump was placed at least 15 cm below the surface to avoid potential contamination. Pond water was pumped for five minutes to purge any contaminants from the pump and hose before the sample was collected. Desilting pond water was obtained from the southeast corner of the pond near the underwater drain structure. Water from the transfer pond was collected from the intake structure pumping feed water to the plant. The runoff pond was sampled at a point along the western shore from the eastern dam separating the runoff from the transfer ponds.

A storm water runoff sample was collected from the ROM coal storage pile using runoff plug collectors (Figure 3-6).

Twelve of these collectors were placed around the northern and eastern perimeter of the raw coal pile on the first day of sampling. Using earth augers, holes were drilled in natural depressions and erosion ditches so that runoff could be collected after a precipitation event. The collectors

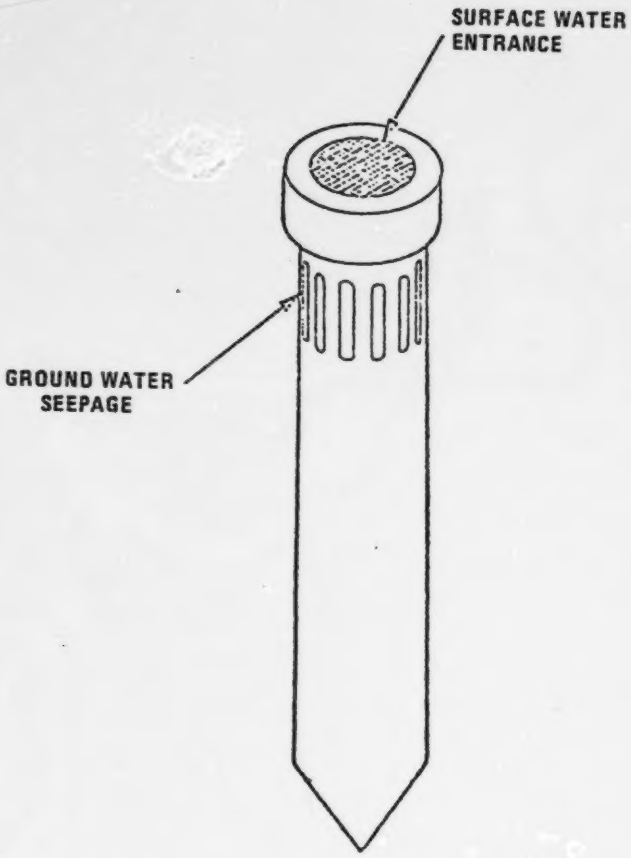


Figure 3-6. Storm water runoff plug collectors.

remained at these locations until the end of the sampling excursion. The contents of each collector was combined and there was a sufficient quantity of water to conduct all of the analyses as shown in Table 3-1, Section 5, except for organics. The collectors were replaced. After two weeks there was sufficient precipitation to collect a runoff sample for organic analysis.

All liquid samples, that is fine waste slurry, pond water, and runoff, were split immediately after collection into aliquots for field and laboratory analyses. Forty-two liters of unfiltered sample were contained and packed in insulated shipping crates, iced, and air freighted to the biological testing laboratory. Two one-liter containers were filled with unfiltered samples, preserved, and air freighted to the analytical laboratory.

Two additional 1,000 ml aliquots were filtered through 47 mm glass fiber filters, and the filters were retained for elemental and mercury analyses. The balance of the water samples were filtered through 18.5 cm Buchner funnels with Whatman 41 filter paper. Ten liters of the filtrate were extracted at pH 2 and pH 10 with methylene chloride. The acid and basic extracts were retained for organic analysis, and the aqueous layer was discarded. Field water quality analyses using portable test kits were initiated immediately on a one-liter aliquot of the filtrate.

Aqueous leachates were prepared in the laboratory from bulk solids, including samples of clean coal, ROM coal, coarse refuse, and sediment from the three ponds. Leachates were prepared by shaking a known weight of solid with deionized water in a ratio of 1 mg of solid to 4 ml of water for 48 hours. The aqueous phase was then separated by filtration and analyzed.

3.4 SOLIDS

3.4.1 Sampling Point Leachates

Coal, refuse, and solid samples include the following:

- Clean coal from automatic sampling system.
- Filtered solids of fine refuse slurry.
- ROM coal from the semi-automatic sampling system.
- Coarse refuse from the refuse bin conveyor.
- Dewatered sediment from desilting, transfer, and runoff ponds.

The approximate locations of the solid sampling points are indicated on Figure 3-1. Table 3-1 in Section 1 lists the types of analyses performed on each of these samples.

3.4.2 Sample Description and Equipment

Two clean coal samples were obtained during the sampling period. A grab sample was collected from the divert stream on the automatic sampling system upstream of the crusher and secondary splitter. A composite sample and packed in insulated shipping crates, iced, and air freighted to the biological testing laboratory. Two one-liter containers were filled with unfiltered samples, preserved, and air freighted to the analytical laboratory.

Two additional 1,000 ml aliquots were filtered through 47 mm glass fiber filters, and the filters were retained for elemental and mercury analyses. The balance of the water samples were filtered through 18.5 cm Buchner funnels with Whatman 41 filter paper. Ten liters of the filtrate were extracted at pH 2 and pH 10 with methylene chloride. The acid and basic extracts were retained for organic analysis, and the aqueous layer was discarded. Field water quality analyses using portable test kits were initiated immediately on a one-liter aliquot of the filtrate.

Aqueous leachates were prepared in the laboratory from bulk solids, including samples of clean coal, ROM coal, coarse refuse, and sediment from the three ponds. Leachates were prepared by shaking a known weight of solid with deionized water in a ratio of 1 mg of solid to 4 ml of water for 48 hours. The aqueous phase was then separated by filtration and analyzed.

3.4 SOLIDS

3.4.1 Sampling Point Leachates

Coal, refuse, and solid samples include the following:

- Clean coal from automatic sampling system.
- Filtered solids of fine refuse slurry.
- ROM coal from the semi-automatic sampling system.
- Coarse refuse from the refuse bin conveyor.
- Dewatered sediment from desilting, transfer, and runoff ponds.

The approximate locations of the solid sampling points are indicated on Figure 3-1. Table 3-1 in Section 1 lists the types of analyses performed on each of these samples.

3.4.2 Sample Description and Equipment

Two clean coal samples were obtained during the sampling period. A grab sample was collected from the divert stream on the automatic sampling system upstream of the crusher and secondary splitter. A composite sample was also collected from the sampling system and represented the entire eight-hour production day. The coal samples were placed in separate 5-gallon pails with polyethylene liners, sealed to prevent moisture loss or oxidation, and shipped to the laboratory for pre-analysis preparation.

Fine waste solids were obtained from the filtration process of the fine waste slurry as described in Section 3.3.

An ROM coal sample was obtained from the semi-automatic sampling system. The primary sampling cutter was cycled three times, the resulting sample was placed in two 5-gallon containers, and the liner was sealed.

Coarse refuse was collected from the conveyor transporting the material from the plant to the loading hopper outside the plant. Cross-stream cuts were taken and two 5-gallon pails were filled with sample material and sealed.

Pond sediment samples were collected at eight locations around the perimeter of each pond using a brass Ekman dredge. The individual aliquots were combined and homogenized to produce a composite sediment sample for each of the three ponds. Each composite was split into separate analytical samples. The 10 kg aliquot for biological analysis was immediately containerized, iced for shipment, and air freighted to the biological testing laboratory.

Prior to analysis, the ROM coal, clean coal, and coarse refuse samples were spread out on polyethylene sheets and allowed to air dry overnight. The material was reduced to 0.63 cm x 0 top size using a jaw crusher. Aliquots for leachate preparation were withdrawn from the crushed sample, containerized, and shipped to the laboratory. The remaining crushed material was ground using a rotary pulverizer and sieved and the <60 mesh material was retained for analysis.

SECTION 4.0

ANALYTICAL PROCEDURES

Both chemical (inorganic and organic) and biological analyses were performed on the samples obtained from coal preparation plant No. 1. Figures 4-1 through 4-6 show the analytical scheme used for each type of sample.

The following subsections contain detailed descriptions of the sample extraction procedures and the analytical methodologies used. The water quality, inorganic, and organic analyses are described in Sections 4.1.1, 4.1.2, and 4.1.3, respectively, and the bioassay tests are described in Section 4.2.

All chemical analyses were performed exactly as specified in the IERL-RTP Level 1 Environmental Assessment procedures. Detail is provided to facilitate understanding of analytical procedures and for comparison with other data.

4.1 INORGANIC AND ORGANIC SPECIES ANALYSES

Inorganic analyses were performed on all wastes from the coal preparation plant. The solid fugitive air emission samples were analyzed by Spark Source Mass Spectrophotometry (SSMS), and all liquid samples were analyzed by both SSMS and by Inductively Coupled Argon Plasma Optical Emission Spectroscopy (ICP-OES) for metals. The inorganic analyses were performed by Commercial Testing and Engineering Company (CT&E), and also by Versar laboratories in Springfield, Virginia.

Organic analyses were performed on pond water, pond sediment, pond sediment leachate, coal leachate, and fugitive gases. The analysis consisted of Total Chromatographable Organics (TCO) and Gravimetric (GRAV) determinations of sample extracts. The samples were analyzed for total

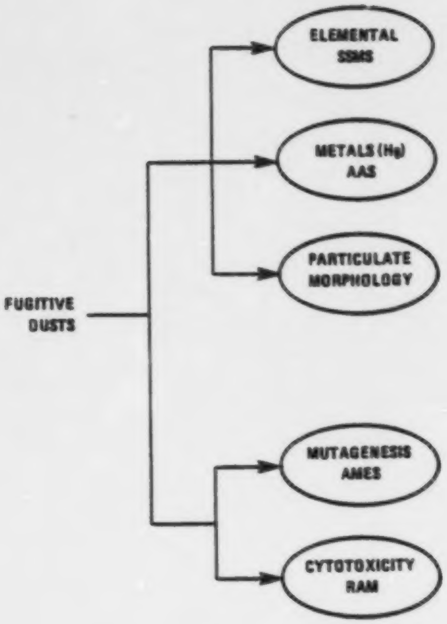

FUGITIVE DUSTS
ELEMENTAL SSMS
METALS (Hg) AAS
PARTICULATE MORPHOLOGY
MUTAGENESIS AMES
CYTOTOXICITY RAM

Figure 4-1. Analytical flow scheme for fugitive dust samples.

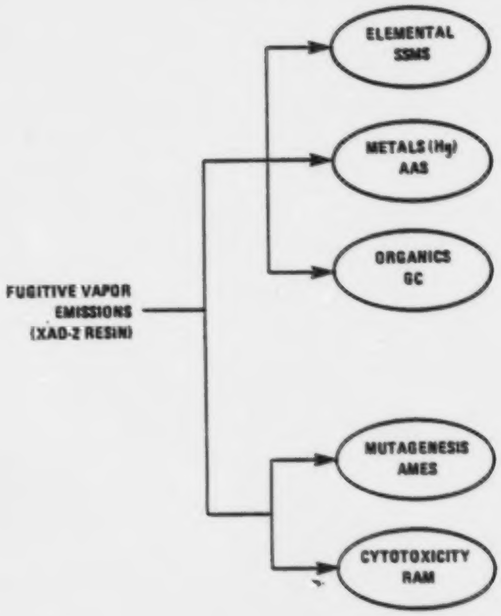

FUGITIVE VAPOR EMISSIONS (XAD-2 RESIN)
ELEMENTAL SSMS
METALS (Hg) AAS
ORGANICS GC
MUTAGENESIS AMES
CYTOTOXICITY RAM

Figure 4-2. Analytical flow scheme for fugitive vapors (XAD-2).

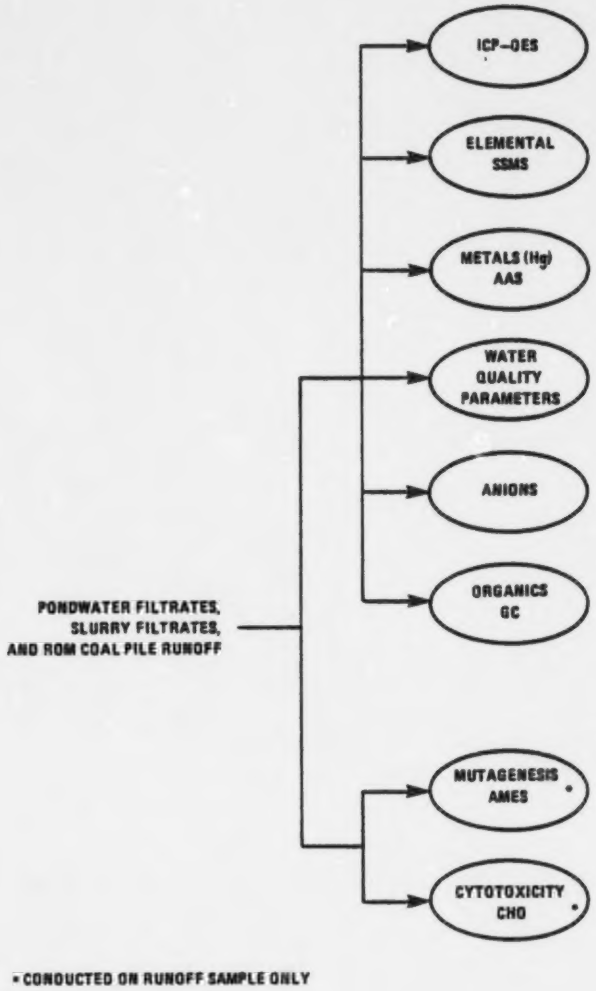
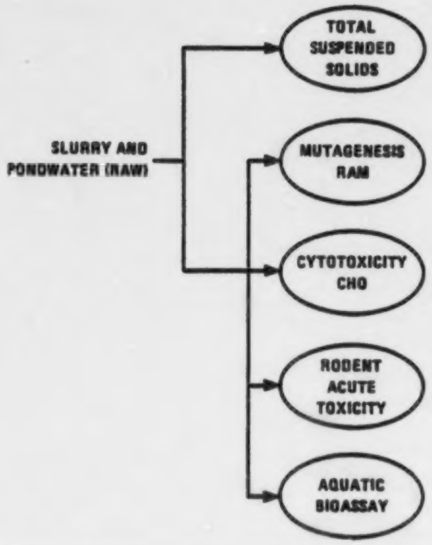
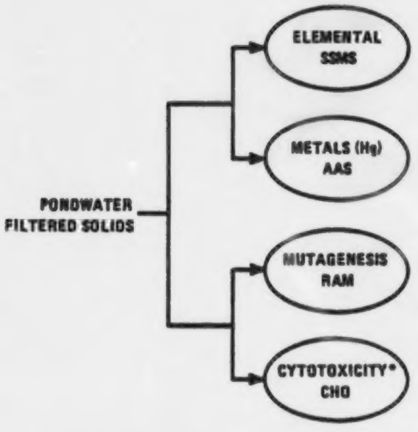

ICP–OES
ELEMENTAL SSMS
METALS (Hg) AAS
WATER QUALITY PARAMETERS
ANIONS
ORGANICS GC
PONDWATER FILTRATES, SLURRY FILTRATES, AND ROM COAL PILE RUNOFF
MUTAGENESIS AMES *
CYTOTOXICITY CHO *
* CONDUCTED ON RUNOFF SAMPLE ONLY

Figure 4-3. Analytical flow scheme for pond water, filtrates, slurry filtrates, and ROM coal pile runoff.


TOTAL SUSPENDED SOLIDS
SLURRY AND PONDWATER (RAW)
MUTAGENESIS RAM
CYTOTOXICITY CHO
RODENT ACUTE TOXICITY
AQUATIC BIOASSAY

ANALYTICAL FLOW SCHEME FOR SLURRY PONDWATER (RAW)


ELEMENTAL SSMS
METALS (Hg) AAS
PONDWATER FILTERED SOLIDS
MUTAGENESIS RAM
CYTOTOXICITY* CHO

* EXCLUDING FILTERED SOLIDS FROM TRANSFER POND

Figure 4-4. Analytical flow scheme for pond water filtered solids.

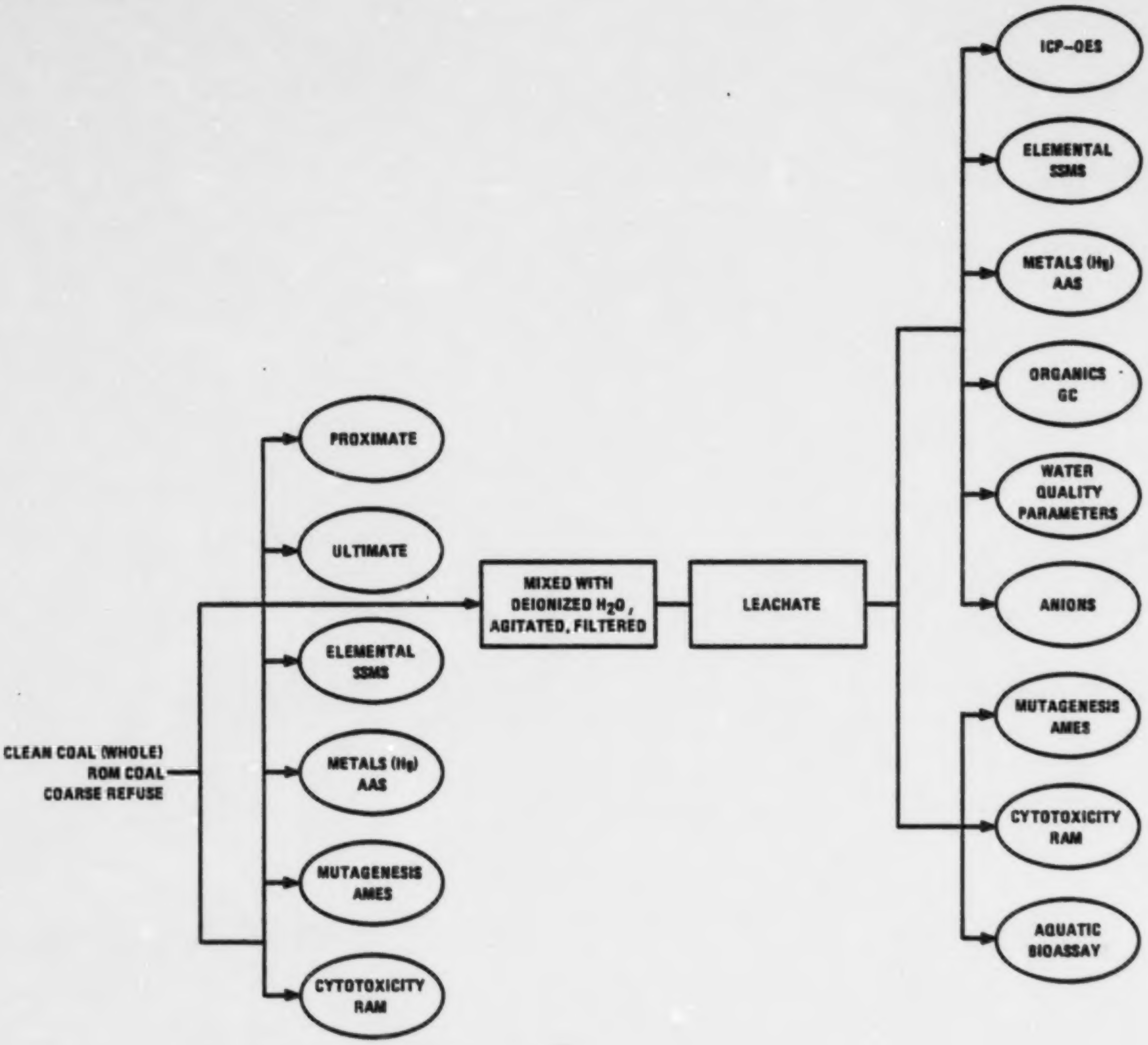
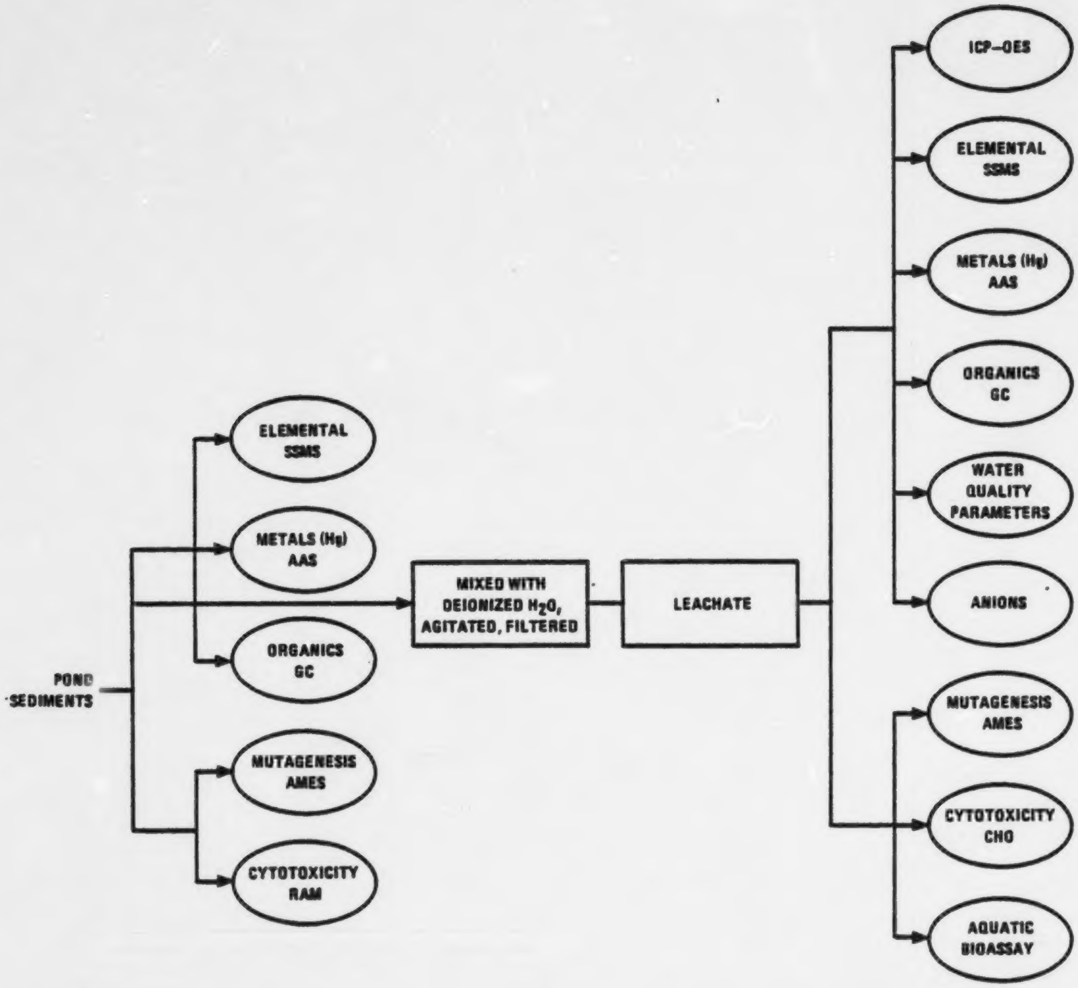

CLEAN COAL (WHOLE)
ROM COAL
COARSE REFUSE
PROXIMATE
ULTIMATE
ELEMENTAL SSMS
METALS (Hg) AAS
MUTAGENESIS AMES
CYTOTOXICITY RAM
MIXED WITH DEIONIZED H_2O, AGITATED, FILTERED
LEACHATE
ICP-OES
ELEMENTAL SSMS
METALS (Hg) AAS
ORGANICS GC
WATER QUALITY PARAMETERS
ANIONS
MUTAGENESIS AMES
CYTOTOXICITY RAM
AQUATIC BIOASSAY

Figure 4-5. Analytical flow scheme for clean coal, ROM coal, and coarse coal.



POND SEDIMENTS
ELEMENTAL SSMS
METALS (Hg) AAS
ORGANICS GC
MUTAGENESIS AMES
CYTOTOXICITY RAM
MIXED WITH DEIONIZED H_2O, AGITATED, FILTERED
LEACHATE
ICP-OES
ELEMENTAL SSMS
METALS (Hg) AAS
ORGANICS GC
WATER QUALITY PARAMETERS
ANIONS
MUTAGENESIS AMES
CYTOTOXICITY CHO
AQUATIC BIOASSAY

Figure 4-6. Analytical flow scheme for pond sediments.

organic content. Individual organic compounds contained in each sample were not identified.

4.1.1 Water Quality Analyses

4.1.1.1 Chemical Oxygen Demand--

Chemical Oxygen Demand (COD) was determined by Standard Method No. 508.(2) The COD determination provides a measure of the amount of organic matter in a wastewater sample that is oxidizable by a strong chemical oxidant. The procedure consists of refluxing the sample with a mixture of potassium dichromate and sulfuric acid utilizing silver sulfate as a catalyst. The excess dichromate is then titrated with a standard ferrous ammonium sulfate solution. The amount of oxidizable organic matter in the waste sample is then proportional to the amount of potassium dichromate consumed by the chemical oxidants as determined by the titration. Inadequacies of the method are that straight chain aliphatic compounds, aromatic hydrocarbons, and pyridine are not oxidized by the chemical process.

4.1.1.2 Biochemical Oxygen Demand--

The Biochemical Oxygen Demand (BOD_5) was determined by Standard Method No. 507.(3) The BOD_5 determination measures the Dissolved Oxygen (DO) in the sample that is consumed by microbial life while assimilating and oxidizing the present organic matter. The procedure consists of measuring the initial DO content of the sample, sealing it in a glass stoppered bottle without air bubbles or headspace, and incubating the prepared samples for five days at 20°C in the dark. After five days of incubation, the DO is again measured and the BOD_5 determined from the reduction in dissolved oxygen. Dissolved oxygen was determined with a calibrated Yellow Spring Instrument Model 54A dissolved oxygen meter and probe.

4.1.1.3 pH--

Sample pH was determined using a Beckman Model SS-3 pH meter according to the EPA Method No. 150.1 (electrometric).(4) The pH meter was calibrated by commercial standard buffer solution. Sample mixing was accomplished with a magnetic stirrer.

4.1.1.4 Conductivity--

Conductivity was measured using a Yellow Spring Instrument Salinity, Conductivity, and Temperature Meter, Model 33 equipped with a Wheatstone Bridge-type probe according to the EPA Method No. 120.1.(5)

4.1.1.5 Hardness--

Hardness was determined by the Standard Method No. 309B, EDTA titrimetric method.(6) Hardness, determined by this method, represents the total concentration of calcium and magnesium ions expressed as calcium carbonate. The pH of the sample is adjusted to 10.0 ±0.1 with a buffer solution. Eriochrome Black T was then added as an indicator changing the solution color to wine red. The sample was then titrated with standard ethylenediamine tetraacetic acid (EDTA) which complexes the magnesium and calcium ions. The endpoint is reached when the solution turns from wine red to blue.

4.1.1.6 Alkalinity--

Alkalinity was determined titrimetrically using EPA Method No. 310.1.(7) An aliquot of the sample was potentiometrically titrated to a pH of 4.5 with a standard acid (sulfuric or hydrochloric). The alkalinity, if measured as calcium carbonate, is an indicator of the concentration of carbonate, bicarbonate, and hydroxide present in the sample.

4.1.1.7 Acidity--

Acidity was determined titrimetrically by EPA Method No. 305.1.(8) The pH of the sample was determined and standard sulfuric acid was added to the sample to a pH of 4. Hydrogen peroxide was added and the sample was boiled. The cooled sample was then titrated electrometrically to a pH of 8.2. The acidity is reported as calcium carbonate and is a measure of the mineral acidity of the sample plus the acidity resulting from oxidation and hydrolysis of polyvalent cations, including salts of iron and aluminum.

4.1.1.8 Ammonia--

Ammonia was determined by EPA Method No. 350.1, the colorimetric automated phenate method.(9) A Technicon Autoanalyzer (AAII) was used for this procedure. The sample was run through the autoanalyzer's manifold where EDTA, an alkaline phenol solution of sodium phenolate, and a sodium hypochlorite solution were added to the sample to form indophenol blue. The blue color was intensified by addition of sodium nitroprusside, and the absorbence of the solution was measured at 660 nanometers through a 50-mm tubular flow cell. A strip chart recorder monitored the response (absorbence) of samples and standards run through the system. By comparing peak heights of standards to samples,the ammonia concentration of each sample was calculated.

4.1.1.9 Nitrogen, Nitrate-Nitrite--

Nitrogen as nitrate and nitrite were measured using EPA Method No. 353.2, a colorimetric, automated cadmium reduction method.(10) This method was performed using a Technicon Autoanalyzer (AAII). By this method, nitrite is measured singly by diazotizing the sample with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine hydrochloride solution to form a highly colored azo-dye. The absorbence is measured through a 15-mm cell at 520 nanometers. Nitrate is determined by passing the sample through a granulated copper-cadmium reduction column to reduce nitrate to nitrite and to determine the nitrite originally present plus the reduced nitrate. Sample concentrations of nitrite and nitrate were determined by comparing their recorder response in peak height with those of standards.

4.1.1.10 Total Phosphorus and Ortho-Phosphate--

Phosphates were determined by EPA Method No. 365.2, a colorimetric, ascorbic acid method.(11) This method determines ortho-phosphate. Total phosphorus is thus determined by first converting the polyphosphates (and some organic phosphorus compounds) to ortho-phosphate by sulfur acid/ammonium persulfate hydrolysis and then determining the ortho-phosphate. Ammonium molybdate and antimony potassium tartrate are added to the sample in an acid medium of sulfuric acid and ascorbic acid. They react to form phosphomolybdic acid. This complex is reduced by the ascorbic acid to an intensely blue color. The absorbence of the blue complex is measured at 650 nanometers through a 50-mm cell using a Bausch and Lomb Spectronic 70 spectrophotometer. The concentration of samples was determined by comparing their absorbence to the absorbence of standards.

4.1.1.11 Sulfide--

Sulfide was determined by EPA Method No. 376.1, the titrimetric iodine method.(12) By this method a known excess of standard iodine is added to a sample that has been preserved with zinc acetate to produce zinc sulfide to sulfur under the acidic conditions. The samples were then back titrated with a reducing solution of standard sodium thiosulfate using a starch indicator to a clear endpoint. The concentration of sulfide is then determined from the amount of iodine consumed by the sulfide present in the sample.

4.1.1.12 Sulfate--

Sulfate was determined using EPA Method No. 375.2.(13) The Technicon Autoanalyzer (AAII) was used for this test. The sample is pumped through a cation-exchange column to remove multivalent metal ions. The sample is then reacted with an alcohol solution of barium chloride and methyl thymol blue (MTB) at a pH of 2.5 to 3.0 to form barium sulfate. The combined solution is raised to a pH of 12.5 to 13.0 so that excess barium reacts with MTB. The uncomplexed MTB color is gray; if it is diluted with barium, the color is blue. The amount of uncomplexed MTB is determined through a 15-mm cell at 460 nanometers. The amount of sulfate present is equal to the amount of uncomplexed MTB. The concentration of sulfate in each sample is calculated by comparison of the recorded response (in peak height) to the peak height of standards.

4.1.1.13 Fluoride (Electrode Method)--

Fluoride was analyzed by Standard Method No. 414B using an Orion Specific Ion Meter Model 701.(14) The fluoride ion-selective electrode is used to measure the concentration of fluoride in aqueous samples by use of a calibration curve of the potential established across a laser-type doped single lanthanium fluoride crystal by the presence of fluoride ion in an internal reference solution. The sample is first treated with a total ion strength adjustment buffer that overcomes variations in sample ionic strength and also contains a chelating agent to preferentially complex aluminum. Standards and samples are allowed to equilibrate to room temperature. The probe is immersed in the standards and samples and the potential measured while stirring the solution for three minutes.

4.1.1.14 Chloride--

Chloride was determined by EPA Method No. 325.3, the mercuric nitrate titrimetric method.(15) An acidified sample is titrated with standardized mercuric nitrate in the presence of mixed diphenylcarbazone - bromophenol blue indicator. The endpoint of the titration is the formation of the blue-violet mercury diphenylcarbazone.

4.1.1.15 Percent Solids--

Percent solids were determined on bulk solids and coal samples according to Standard Method No. 208G.(16) By this method the solids content was determined by drying a 50-100 g aliquot of sample at 104°C. The samples were weighed in dried, tared procelain weighing dishes. After drying, the samples were cooled to room temperature in a desiccator and reweighed.

4.1.1.16 Leachate--

Leachates were prepared from pond sediment and coal samples for subsequent inorganic and organics analysis by the ASTM Proposed Method for Leaching of Waste Materials.(17) For coal samples a 1-kg aliquot was weighed and combined with a liter of deionized water in a 5-gallon glass jug with a teflon-sealed lid. A 2-kg aliquot was used for pond sediments, and 8 ℓ of deionized water were added to the samples. The samples were agitated on a roller mill for 48 hours, allowed to settle, and then coarse-filtered through 7 μ glass fiber filters on a Buchner filtration unit. The filtrates were filtered twice through 0.45 μ membrane filters and then split into appropriate sample containers for subsequent analysis. The samples were preserved and stored at 4°C until analyzed.

4.1.2 Elemental Analysis (Spark Source Mass Spectrometer)

Spark source mass spectrometry is one of the most sensitive multi-element techniques available for trace element analysis at the present time. Very low detection limits for all elements as well as total element coverage in a minimum time makes the technique a viable one for survey work.

The spark source mass spectrometer, installed and operating at the Instrumental Analysis Division of CTE, is an Associated Electrical Industries

Model MS7 which is a Mattauch-type double focusing mass spectrometer specifically designed for the analysis of inorganic materials.

The design of the MS7 is based on the use of a spark ionization source to ensure that all elements are ionized with approximately equal sensitivity. This instrument utilizes a photographic plate as a detector. The photographic plate is a simple total integrator for the ion beam and a convenient permanent record of the mass spectra produced by the instrument. The photographic plate allows the highest resolving power of the instrument to provide maximum molecular and elemental species discrimination.

On a routine basis, the spark source mass spectrometer will give a trace element examination of all elemental constituents from lithium (mass 7) to uranium (mass 238) in as little as one hour.

4.1.2.1 Calibration--

The spark source mass spectrometer is not in itself calibrated. Each sample analyzed has an internal standard of indium added at a known concentration during sample preparation. Elements detected are analyzed quantitatively by comparison with indium. Photoplates do give a different response to high m/e ions as compared to lower m/e ions. This difference in response is normally taken into account by the use of relative sensitivity factors for element determinations. Relative sensitivity factors were established in a carbon matrix by the use of NBS coal, fly ash, bovine liver, orchard leaves standards, USGS water, and geological standards.

4.1.2.2 Spark Source Mass Spectrometer Analysis Quality Control--

Quality control is maintained by periodically running NBS and other reference standards so that sets of reference spectra can be obtained for evaluation against routine samples. The number of reference standard analyses are determined by the sample load within the laboratory. Routinely, one or two standards are run every month and also when photographic plates from a new production lot are used.

4.1.2.3 Sample Analysis--

In the analysis of coals and refuse, the procedure includes the systematic division and reduction of the sample to minus 200 mesh. A portion of the coal is then mixed with an equal weight of high purity compactable graphite. An internal element standard, normally indium, is added along with a few drops of distilled ethyl alcohol. The mixture is slurried with distilled alcohol in an agate mortar and pestle. The sample-graphite slurry is evaporated until dry. The procedure is then repeated until a homogeneous electrode mixture is assured. The sample-graphite mix is then formed into electrodes that are mounted in the source for sparking.

The mass spectrum is produced on a photoplate as a series of distinct lines, one for each element, and is a summation of the elemental components of the electrode. The ion intensity of each spectral line is related directly to the concentration of the components, at least over a concentration range of 10^5:1. Therefore, by running a series of decreasing exposures, the relative concentration of major to trace elements can be established by knowing the concentration of the internal standard added during sample preparation.

Particulate samples collected on ultra-high purity glass fiber filters with the high volume samplers must be separated from the filter substrate before analysis. A portion of the filter is cut and placed in a glass centrifuge tube. The filter is then covered with spectrographic grade ethyl alcohol. The centrifuge tube and alcohol are subjected to ultrasonic shaking to remove the particulates from the surface and interior of the filter. The main portion of the cleaned filter is then removed and rinsed with alcohol, and the tube is centrifuged for a few minutes. The solids are quantitatively transferred to a mortar with the graphite and an electrode is formed. Liquid samples are prepared by evaporating successive aliquots with a heat lamp, mixing the residue with graphite, and forming an electrode.

4.1.2.4 Inductively Coupled Argon Plasma Optical Emission Spectroscopy--

A number of quality assurance samples prepared by the prime contractor were included with the initial samples submitted to the subcontractor for SSMS analysis. These control samples included method standards, blanks, and duplicate samples. The analyses of these control samples were then reviewed to evaluate the accuracy and precision of the SSMS data. Review of these data indicated the potential for serious problems in both the precision and accuracy of the SSMS data. To study these problems in more detail, all of the liquid samples obtained from the preparation plant and leachates derived from solid samples were analyzed by ICP-OES in the prime contractor's laboratory.

Liquid samples (water samples and solid leachates) were analyzed by ICP-OES after preliminary acid digestion. The concentrations for 27 elements listed below were measured utilizing a Jarrell-Ash Model 1140 ICP-OES system.

Aluminum
Antimony
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Gallium
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Silver
Sodium
Strontium
Tin
Titanium
Vanadium
Yttrium
Zinc

The digestion procedure utilized was designed to allow the determination of "total" metals content of the sample. These procedures are described in the Federal Register, Volume 44, No. 233, December 3, 1979. Results of these analyses have been included in this report in Appendix B along with comparable SSMS data. A qualitative review of these data points to a lack of precision and accuracy in the SSMS data.

A quantitative evaluation of these results on an element-by-element basis was not possible because of a lack of sufficient data. To provide such an evaluation, the environmental assessment program will continue to duplicate the SSMS analyses with ICP-OES analyses. The number of quality assurance samples will also be increased to provide a larger data base on which to make a quantitative comparsion.

4.1.2.5 Mercury Determinations--

All solid samples (fugitive dusts, sediments, slurries, and coal samples) were prepared for analysis utilizing the six-hour aqua-regia digestion procedure described in Appendix D of IERL-RTP Procedures Manual: Level 1 Environmental Assessment (second edition).(18) Solid sample digestates and water samples were then analyzed for mercury utilizing the cold vapor atomic absorption method, number 245.1, described in "Methods for Chemical Analysis of Water and Wastes," March 1979, EMSL, U.S. EPA, Cincinnati, Ohio.(19)

4.1.3 Organics Analysis

4.1.3.1 Pond Water Extractions--

Aliquots of the pond water samples were filtered and extracted in-situ as discussed in Section 3.3.2. The extracts were transported to the laboratory in amber glass bottles with teflon seals and were stored at 4°C until analyzed. Prior to analysis, the sample extracts were dried and filtered through a column of sodium sulfate and concentrated to 10 ml by evaporation with Kuderna-Danish apparatus on a steam bath at 65 to 70°C.

4.1.3.2 Pond Sediment Extractions--

One hundred gram aliquots of the pond sediments were weighed into glass thimbles with coarse frits and secured with a glass wool plug. They were then soxhlet extracted with methylene chloride for 24 hours. The extract was dried and filtered through a column of sodium sulfate and concentrated to 10 ml by Kuderna-Danish evaporation on a steam bath at 65 to 70°C.

4.1.3.3 Pond Sediment Leachate and Coal Leachate Extractions--

A one liter aliquot of each leachate was extracted with methylene chloride at two pH levels, pH 2.0 and pH 12.0, using a two liter separatory funnel with Teflon stopcocks. Three extractions were performed at each pH level, using a total of 450 ml of methylene chloride. The individual extracts were combined, filtered, and dried through a sodium sulfate column. The acid and base extracts were then concentrated to 10 ml by evaporation using a Kuderna-Danish apparatus on a steam bath at 65 to 70°C.

4.1.3.4 XAD-2 Resin Extractions--

A representative aliquot of the XAD-2 resin was weighed into glass thimbles with coarse frits, secured with glass wool plugs, and soxhlet extracted with methylene chloride for 24 hours. The extracts were dried and filtered through a column of sodium sulfate and concentrated to 10 ml by Kuderna-Danish evaporation on a steam bath at 65 to 70°C.

4.1.3.5 Total Chromatographable Organics Analysis(20)--

The Total Chromatographable Organics (TCO) analysis was performed on concentrates after preliminary review showed very low levels by direct injection. The analysis was performed on a Hewlett-Packard 5710 gas chromatograph (GC) equipped with Flame Ionization Detector (FID) interfaced with a HP 3380 A integrator. Five microliter injections of each 10 ml extract were chromatographed under the following GC conditions:

Column: 6' x 2 mm I.D. Glass, packed with 10 percent OV-101 on 100/120 Mesh Supelcoport (Supelco)

Carrier Gas: Helium, Matheson Purity (99.9999)

Carrier Gas Flow: 40 ml/min

Run Time: 30 minutes

Oven Temperature Program:

TEMPI	30°C for 4 minutes
RAMP	16°C/min
FINAL TEMP	250°C

Detector Temperature:	300°C
Injection Port Temp:	250°C
Attenuation:	32

The FID detector and GC conditions were optimized daily to a 5 microliter injection of standard n-heptane solution. A five point calibration curve was constructed from a standard mixture of individual straight chain alkanes, n-hexane through n-heptadecane. The peak maxima of n-heptane and n-heptadecane were used to determine the retention time window for the analysis of the TCO materials within the 100°-300° boiling point range. For standards, the integrated areas of the peaks for n-octane through n-hexadecane were summed and plotted versus concentration. The areas of all peaks eluting within the C_7-C_{17} retention time window were calculated for the samples, a reagent blank value was subtracted, and concentrations were determined using the C_8-C_{16} calibration curve slope and y-intercept.

All chromatograms, extracts, and analyst worknotes are kept on file for at least one year after completion of the Level 1 assessment to provide any and all re-analysis that might be required to provide the most accurate analyses.

4.1.3.6 Gravimetric Analysis--

Gravimetric analysis of the 10 ml organic extracts was performed by pipetting 1 ml of the extract into a 2 ml tared glass weighing vial. The vials were placed in a desiccator and dried to a constant weight over drierite and reweighed. The difference in weight provided the gravimetric value.

4.1.3.7 Infrared Analysis--

Analysis by IR spectroscopy was not employed in this Level 1 assessment.

4.1.3.8 Liquid Chromatography - Low Resolution Mass Spectra Analysis--

The Liquid Chromatographic (LC) separation and L Resolution Mass Spectra Analysis (LRMS) are required when extracts are found to have a TCO + Grav of $\geq$15 mg. Since no extracts fall into this classification, these analyses were not required.

4.2 BIOASSAY ANALYSIS

The objective of the tests for health and ecological effects is to perform a biological evaluation of materials associated with the waste streams from a coal preparation plant. The materials evaluated include coal, refuse, sediments, feed water, pond waters, particulates, fugitive organics, runoff, and leachates. Thirty-five samples of these materials were evaluated by one or more of the following tests: Salmonella/Microsome Mutagenesis (Ames) Assay, Rabbit Alveolar Macrophage (RAM) Assay, Chinese Hamster Ovary (CHO) Clonal Assay, Rodent Acute In-Vivo Test, and aquatic bioassays with a fish (fathead minnow, _Pimephales Promelas_), an invertebrate (water flea, _Daphnia magna_), and an alga (_Selenastrum capricornutum_).

4.2.1 The Ames Test

The Salmonella/Microsome Mutagenicity (Ames) Assays were conducted with four auxotrophic strains of _Salmonella typhimurium_ according to procedures in Section 3.3.1 of IERL's procedural manual (U.S. EPA, 1977),(21) using specifications described in Ames et al., (1975).(22) Liquid samples were tested as received and filter papers were extracted with 40.0 ml sterile distilled water. Solids were pulverized with a mortar and pestle, filtered (0.45 μ), and oven dried.

The Ames test will be used as a primary screen to determine the mutagenic potential of complex mixtures or component fractions. The Ames assay is based on the property of selected Salmonella typhimurium mutants to revert from a histidine-requiring state to prototrophy due to exposure to various classes of mutagens. The test can detect nanogram quantities of mutagens.

Prior to mutagenicity testing, toxicity of each sample was determined with two bacterial tester strains. Excess histidine was added to the top agar and low initial cell counts (10^3 cells/ml) were employed to allow the auxotrophic bacteria to proliferate and grow. If sample plate counts were much lower than the control plate counts, then the sample was considered toxic at that concentration. If toxicity occurred, concentrations employed in the mutagenicity assay would be one-half of the lowest toxic concentration observed during this phase of testing.

Toxicity testing was performed with tester strains TA 98 and TA 100, which were each cultivated in 45 ml nutrient broth, and diluted to a cell concentration of 10^2-10^3 cells/ml in 0.85 percent saline solution. Media were prepared by addition of 10 ml excess histidine-biotin to 100 ml tempered top agar and dispensed into sterile test tubes (13 x 100 mm) in 2-ml aliquots. Three concentrations of each field sample were tested with 0.1 ml of each tester strain. This top agar solution was gently shaken and evenly spread on the surface of Vogel-Bonner minimal salt medium plates. Each test was performed in duplicate. Plates were incubated for 48 hours at 37°C and examined to determine if cell death had occurred. The concentrations of samples employed in the mutagenicity assay were less than one-half of the least toxic level.

Mutagenicity testing was performed with tester strains TA 98, TA 100, TA 1535, and TA 1537, each of which was cultivated in 45 ml nutrient broth. Media were prepared by addition of 10 ml trace histidine-biotin to 100 ml tempered top agar and dispersed into sterile test tubes (13 x 100 mm) in 2-ml aliquots. Four concentrations (0.05-1.0 ml sample/tube) of each field sample were tested with 0.1 ml of each tester strain. This top agar solution was gently shaken and evenly spread on the surface of Vogel-Bonner minimal salt medium plates. Each test was performed in duplicate. Plates were incubated for 48 hours at 37°C and examined to determine if cell reversion rates had increased. If a compound caused a reversion rate twice the spontaneous reversion rate, the substance was considered positively mutagenic. If a sample exhibited a positive result in the initial mutagenicity test, it was re-evaluated using a narrower range of concentrations. These results were then used to compute a dose-response curve.

Due to the nature of certain samples, a spot test was employed initially to determine toxicity and mutagenicity. The procedures for both tests were unchanged, except that top agar was layered onto the Vogel-Bonner plates before the sample was introduced. The sample was placed on the surface of the plate and incubated at 37°C for 48 hours. A clear zone around the spot extending out into the medium was an indication of toxicity. A zone of increased reversion around a spot sample, particularly if excessive, was an indication of mutagenesis.

4.2.2 Chinese Hamster Ovary Clonal Assay

Chinese Hamster Ovary (CHO) Clonal Assays were conducted according to Section 3.3.2.3 of IERL's procedural manual (U.S. EPA, 1977),(23) with detailed procedures drawn from Winniger et al., (1978).(24)

Cultures of Chinese hamster ovary cells (ATCC-CCL61) at 80 percent confluency in 25 cm^2 tissue culture flasks were prepared for testing by harvesting (i.e., 2 to 5 minute treatment at 37°C with 0.25 percent trypsin in calcium- and magnesium-free phosphate buffered saline). After detachment of cells from the flask, an equal volume of complete culture medium was added [nutrient medium F10 supplemented with 10 percent fetal calf serum, penicillin (100 units/ml), and streptomycin (100 µg/ml)]. The suspended cells were centrifuged (200 X g) at room temperature for 10 minutes and the supernatant was discarded. The cells were resuspended in 10 ml complete culture medium, and then counted with a haemocytometer or automatic cell counter. Cells were diluted in complete culture medium to a concentration of 1,000 cells/10 ml. Cell suspensions were prepared in

500 ml sterile glass bottles filled to 50 percent capacity. Ten ml aliquots of the cell suspension were dispensed into 15 x 100 mm tissue culture Petri dishes and incubated in a moist atmosphere (95 percent air/5 percent CO_2) at 37°C for 18 to 24 hours. After this time, the culture medium was removed by aspiration and replaced with 10 ml of complete media containing the various concentrations of test materials, negative (culture medium) or positive (cadmium chloride, 0.05 to 0.20 g/ml) controls. Cultures were incubated in a moist atmosphere at 37°C for 5 to 6 days, after which time the culture medium was removed and the cells fixed with 5 ml fixative (10 percent formaldehyde, 0.5 percent sodium chloride, and 4 percent methanol in deionized water) for 5 minutes at room temperature. After removal of fixative, cells were stained with 5 ml, 0.04 percent crystal violet for 5 minutes at room temperature, washed three times with deionized water, and air dried. The number of colonies produced was counted using an automatic colony counter.

The percent colony survival was determined according to the formula:

$$\frac{\text{Colonies in test sample}}{\text{Colonies in medium control}} \times 100 = \%\ \text{colony survival.}$$

The EC_{50} (effective concentration producing 50 percent colony survival) was calculated from the log concentration versus percent response graph.

4.2.3 Rodent Acute In-Vivo Test

Rodent acute in-vivo tests were performed according to Section 3.3.3 of IERL's procedures manual (U.S. EPA, 1977).(25) Five male and five female Sprague-Dawley rats (approximately 250 g) were quarantined under close scrutiny for a minimum of 7 days to assure healthy test groups. Animals were fed a nutritionally balanced standard commercial laboratory feed that supports normal growth and maintenance. Food and water were supplied ad libitum.

On day 0 of the study, rats were administered an acute dose of undiluted test material equal to 10 g/kg body weight by intra-gastric gavage. After treatment the rats were held 14 days for observation. Clinical signs of toxicity were recorded daily beginning on day 0. Observations included bizarre physical positions, bizarre tail positions, righting reflexes, lethargy, spontaneous convulsions, tremors, behavioral changes, sleep, coma, salivation, and lacrimation. Also noted were any signs of dyspnea, cyanosis, nasal discharge, abnormal excreta, skin abnormalities, pilo erection, changes in food consumption and body weight, and mortality. Frequency and severity of all observed abnormalities was scored, and onset and disappearance of clinical signs was noted. Animals that became moribund or judged unable to live 24 hours were killed and necropsied. At termination of the study all surviving animals were killed and necropsied. If no mortality occurred in the quantal study, no further investigations were performed, and the LC_{50} (lethal dose for 50 percent of the animals) was reported as greater than 10 g/kg.

4.2.4 Rabbit Alveolar Macrophage Assay

Rabbit Alveolar Macrophage (RAM) Assays were conducted according to Section 3.3.2.1 of IERL's procedural manual (U.S. EPA, 1977),(26) with detailed procedures drawn from Waters (1975), and Gardner et al., (1973).(27)

Alveolar macrophage cells were obtained from the lungs of male or female white New Zealand rabbits (1.3.3.5 kg) by tracheobronchial lavage. Tracheobronchial lavage consisted of the injection of 30 ml sterile 0.85 percent sodium chloride (warmed to 37°C) into the lungs, and the collection of the fluid (now containing cells) after 15 minutes. Fluid was dispensed into 50 ml centrifuge tubes and the procedure repeated an additional five times (after the first injection, the 15-minute contact period was omitted). If lavage fluid was contaminated with erythrocytes, it was discarded.

Samples were prepared for testing by several techniques. Liquid samples were tested as received. Solids were pulverized in a wedgewood morter and pestle, and added to sterile deionized water in 100 ml glass bottles at the rate of 40 mg sample per 10 ml water. Filter papers were placed in 20 x mm petri dishes containing deionized water at the rate of 300 mg filter paper per 10 ml water. After a 15-minute contact time, the water was repipetted over the filter paper ten times and the particulate suspension was transferred to a sterile 100 ml glass bottle.

One ml aliquots of cell suspension were dispensed into each well of a 3.5 x 1.0 cm Linbro six-well plate. One ml of each concentration of sample was added to each well and agitated. Each concentration was tested in duplicate wells. Plates were incubated in a moist atmosphere (95 percent air/5 percent CO_2) at 37°C on a rocker platform set at 20 excursions per minute. Following a 20-hour incubation period, plates were iced, and the contents of each well were repipetted four times and dispensed into 12 x 75 mm test tubes (iced).

The number of cells was measured directly with a haemacytometer. The percent viability was determined by centrifuging (8,000 X g) a 200 µl aliquot of cell suspension at room temperature for five minutes and by discarding the supernatant. The centrifuged cells were treated with 100 µl of 0.04 percent Trypan blue and vortexed. After a 10-minute exposure at room temperature, the cells were examined microscopically for dye exclusion.

The percent phagocytosis was determined by centrifuging 1.8 ml of cell suspension (5,000 X g) at 4°C for 10 minutes and by discarding the supernatant. The centrifuged cells were resuspended in complete culture medium containing 1.09 µl diameter latex beads at the rate of 20 beads per cell. Cell suspensions were incubated in a moist atmosphere (95 percent air/ 5 percent CO_2) on a rocker platform (20 excursions per minute). After 60 minutes of incubation, smears were prepared on microscope slides. Extracellular latex beads were dissolved by treating the slides for three hours with xylene. One hundred cells were then examined microscopically and the percent of cells that had ingested one or more beads was determined.

Cytotoxicity determinations were based on the median effective concentration (EC_{50}) values calculated from the ATP content of each well and the percent phagocytosis. These two parameters were selected to assess cytotoxicity because these were the most sensitive indicators of toxicity. EC_{50} values were derived by graphical interpolation between data points bracketing the 50 percent effect concentration.

4.2.5 Aquatic Bioassays with Fish and Invertebrates

Aquatic bioassays with fish were conducted with fathead minnows (*Pimephales promelas*) according to procedures in Section 3.4.2 of IERL's procedural manual (U.S. EPA, 1977).(28) Tests were conducted at 22±1°C (established in a walk-in environmental chamber) with dechlorinated tap water used as diluent and control water. This water exhibited the following physical/chemical characteristics: hardness - 42 mg/ℓ; alkalinity - 33 mg/ℓ; TOC - 5 mg/ℓ; suspended solids - <5 mg/ℓ; conductivity - 250 μmhos/cm; and has been shown repeatedly to allow survival of first instar Daphnia magna for 48 hours without food. Fish employed in the tests were obtained from a commercial supplier and held at 20-22°C in diluent water under recirculating conditions for a minimum of four days prior to testing. Mortality of fish during the 48 hours prior to testing was less than five percent.

Fish were exposed to six concentrations of sample (0 percent, 100 percent, 60 percent, 40 percent, 25 percent, and 15 percent), with one replicate per concentration. Each replicate consisted of 10 fish in a 19 ℓ all-glass aquarium containing 10 ℓ of test solution. Fish were randomly placed in the six aquaria within one hour after test solutions had been added, and aquaria were randomly positioned in the environmental chamber. A photoperiod of 16 hours of light and 8 hours of dark was provided during testing. The test was conducted for 96 hours, during which the fish were not fed. Survival and sublethal responses of fish were recorded at 0, 2, 4, 8, 12, 24, 48, 72, and 96 hours after exposure to samples. Dead fish were removed from aquaria at these times. Temperature of the environmental chamber was continuously recorded (Model RFT Recording Thermometer). Dissolved oxygen concentration (YSI Model 57 Meter) was measured in each aquarium at initiation of testing and thereafter at 24-hour intervals. Conductivity (USI Model 33 Meter) and pH (Orion Research Model 701 Meter) were recorded in each aquarium at initiation of testing.

Median lethal concentrations (LC_{50}) for animals exposed to test samples were calculated for 24, 48, and 96 hours of exposure. The moving average method was employed and the LC_{50} generated with the largest data span.

Aquatic bioassays with the invertebrate Daphnia magna were conducted according to procedures in Section 3.4.2 of IERL's procedural manual (U.S. EPA, 1977).(29) Tests were conducted at 17 ±1°C (established in an incubator) with the same dechlorinated tap water used as diluent and control water.

Daphnia magna used in the tests were obtained from laboratory cultures maintained according to procedures in Standard Methods for the Examination of Water and Wastewater (APHA, 1975).(30) Cultures were maintained in dechlorinated tap water at 17 ±1°C. First instar juveniles were used for all tests. Daphnia magna were exposed to six concentrations of sample (0 percent, 100 percent, 60 percent, 40 percent, 25 percent, and 15 percent) with four replicates per concentration. Each replicate consisted of five Daphnia magna in a 250 ml glass beaker containing 100 ml of test solution.

Animals were randomly placed in the test vessels within one hour after test solutions had been added, and test vessels were randomly positioned in the incubator. A photoperiod of 16 hours of light and 8 hours of dark was provided during the tests. The test was conducted for 48 hours during which the animals were not fed. Survival and sublethal responses (immobilization) were recorded at 0, 2, 4, 8, 12, 24, and 48 hours after exposure to samples. Immobilized animals were removed from the test vessels at those times. Temperature of the incubator was continuously monitored. Dissolved oxygen was measured in one replicate test vessel of each concentration at initiation of the test.

Median effective concentrations (EC_{50}) based on immobilization for animals exposed to test samples were calculated for 24 and 48 hours of exposure by Stephan's (1978) computer program.(31) The moving average method was employed and the EC_{50} generated with the largest data span was selected.

4.2.6 Aquatic Bioassay with Algae

The alga Selenastrum capricornutum was tested according to methods described in Section 3.4.1 of IERL's procedural manual (U.S. EPA, 1977).(32) All samples were filtered (0.45 membrane filter) prior to use. The cultures of Selenastrum capricornutum were transferred to sterile Bristol's solution which is prepared by addition of the following compounds to 1 ℓ of distilled water:

$NaNO_3$	25.0 mg
$CaCl_2$	2.50 mg
$MgSO_4 \cdot 7H_2O$	7.50 mg
K_2HPO_4	7.50 mg
KH_2PO_4	17.50 mg
$NaCl_2$	2.50 mg
$FeCl_3$	0.50 mg

Cultures were transferred to sterile Bristol's solution in 250 ml Erlenmeyer flasks containing 60 ml of media, a minimum of three times prior to testing. Cultures were maintained at 24 ±2°C under continuous lighting at 400 foot-candles delivered by fluorescent lights. Test inoculum was prepared by centrifuging (1,000 X g) cells for a seven-day old culture, resuspending the cells in a 15,000 µg/ℓ $NaHCO_3$ solution, recentrifuging, and resuspending the cells in the $NaHCO_3$ solution to yield a concentration of 60,000 cells/ml. Four test concentrations (0 percent sample, 100 percent, 50 percent, and 10 percent) were established, with three replicates employed per concentration and with Bristol's solution used for dilution and control purposes. In preparing each replicate of a test solution, 1 ml of test inoculum was combined with 59 ml of test medium in a 250 ml Erlenmeyer flask, and resulted in an initial concentration of 1,000 algal cells per ml of solution. The test was conducted to 21 days under the experimental conditions described for the preparatory incubation period except that test flasks were randomly positioned on a rotary shaker platform. On days 1, 2, 3, 4, 5, 6, 7, 9, 12, 17, and 21, the number of cells per ml in each replicate of each test solution (concentration) was determined by haemocytometer measurement; for days 12, 17, and 21, the average number of cells in each non-control solution was divided by the average number of cells in the control solution. These quotients were multiplied by 100 (percent of control) and the median effective concentration (EC_{50}) for the diatom was derived by graphical interpolation on semilogarithmic paper between data points bracketing the EC_{50}. The specific growth rate was determined for the control and each non-control solution for days 1, 2, 3, 4, 5, 7, 9, 12, 17, and 21 according to the following formula:

$$\text{specific growth rate} = \frac{\ln \text{(cell concentration at end of interval/cell concentration at beginning of interval)}}{\text{length of interval (days)}}$$

SECTION 5.0

TEST RESULTS

The test results of the Source Test and Evaluation program for coal preparation plant No. 2 are presented in this section. Section 5.1 provides the methodology for evaluating test results, and Section 5.2 contains the chemical and biological test results for each waste stream and an evaluation of the data.

5.1 METHODS OF CHARACTERIZING WASTE STREAMS

Three methods were used to evaluate the characteristics of the waste streams from the coal preparation plant:

- Source Analysis Model 1A (SAM/1A) evaluation.
- Water quality parameter comparisons with existing standards.
- Bioassay screening tests.

5.1.1 SAM/1A Evaluation

The Energy Assessment and Control Division of the EPA's Industrial Environmental Research Laboratory at Research Triangle Park (EACD/IERL-RTP) has developed a standardized methodology for interpreting the results obtained from environmental assessment test programs. This methodology uses Source Analysis Models (SAM's) which represent prototype approaches to multimedia, multipollutant problem identification and control effectiveness evaluation for complex effluents.

The simplest member of the Source Analysis Models, SAM/1A, was used for this STE program. SAM/1A provides a rapid screening technique for evaluating the pollution potential of gaseous, liquid, and solid waste streams. In performing a SAM/1A evaluation, an index, the Discharge Severity (DS), is determined for each substance in a discharge.

The DS is calculated by dividing the detected concentration of a compound, or class of compounds, by its Discharge Multimedia Environmental Goal (DMEG) value (for both health and ecological effects) as reported in Volume II of Multimedia Environmental Goals for Environmental Assessment.(33) The MEG's are concentration levels of contaminants in air, water, or solid waste effluents that will not evoke significant harmful responses if exposed to humans or to the ecosystem.

For example, the estimated concentration of aluminum in the fine waste slurry filtrate sample was analyzed to be 190 μg/ℓ. The health-based DMEG value for aluminum in a liquid discharge is 8.0×10^4 as stated in Volume II of Multimedia Environmental Goals for Environmental Assessment. The discharge severity for aluminum is calculated to be:

$$DS = \frac{190\ \mu g/\ell}{8.0 \times 10^4\ \mu g/\ell} = 2.4 \times 10^{-3}$$

A DS value greater than one indicates a potential hazard, while a value less than one indicates little or no potential hazard. A Total Stream Discharge Severity (TDS) is calculated by summing the DS's for all constituents found in a sample.

$$\text{Total Discharge Severity (TDS)} = \Sigma DS$$

There are several assumptions and limitations implicit in the use of the SAM/1A evaluation technique.(34) These include:

- Transport of the components in the waste streams to the external environment occurs without chemical or physical transformation of those components.
- Actual dispersion of a pollutant from a source to a receptor will be equal to, or greater than, the safety factors normally applied to acute toxicity data to convert these data to estimated safe chronic exposure levels.

- Extrapolation of acute toxicity data for animals (i.e., LD_{50}) to no effects levels in man entails many assumptions which are not properly validated.

- No consideration has been given to additive effects from simultaneous exposure through different media.

- The MEGs methodology does not consider synergisms or antagonisms with regard to health or ecology. Severity is considered as simply additive.

- The biological fate, i.e., metabolism and site of action of chemicals, is not considered. Metabolic alterations into more or less active metabolites, i.e., intoxication and detoxication, are not considered.

- Persistence in the environment with regard to bioaccumulation or degradation is not specifically considered in the current MEGs.

- Use of Threshold Limit Values (TLVs®). ACGIH has made it clear that the TLVs® are to be used only in the practice of industrial hygiene and that it does not recommend their use as a relative index of hazard or toxicity.

- The level of confidence associated with MEG values derived from the models is not known. Information reported in the NIOSH Registry of Toxic Effects of Chemical Substances has been used extensively in calculating MEG values. NIOSH, in compiling the Registry, made no attempt to report the numbers of animals tested, quantity or site of tumors produced in carcinogenicity studies, or precise conditions under which the data were obtained. The level of confidence to be associated with toxicity data such as LD_{50}, LD_{10}, TD_{10}, LC_{50}, or LC_{10} is dependent upon this information.

- LD_{50} values may vary widely for a given compound in relation to species, sex, and age of the animals tested, the route of administration of the toxicant, and other test conditions. Because they are available for most compounds, oral LD_{50} values have been employed rather than LD_{50} values derived from other routes of administration. While this procedure allows for consistency in the calculations and LD_{50} values are the basis of some models based on correlations of LD_{50}s with TLVs®, obvious complications in the use of LD_{50} values arise, e.g., differences in the oral absorption factors among the various chemical substances.

These assumptions, along with the accuracy of the test data and assumptions used in developing DMEG values, must be considered when interpreting test results using the SAM/1A methodology. It should be noted that, based on updated information from Research Triangle Institute, the ecological DMEG values for solids should be two orders of magnitude higher than the values reported in the November 1977 Multimedia Environmental Goals for Environmental Assessment Volume II publication. The higher values were used in the SAM/1A evaluation.

Results of the inorganic analyses were evaluated using SAM/1A. The inorganic data were obtained from trace element, water quality, and gaseous species analyses. When calculating the discharge severity and total discharge severity values, the inductively coupled argon plasma (ICP) analytical concentrations were used for the 27 elements listed in Section 4.1.2.4.

The total concentration of organic extractables in each sample was obtained from Grav and TCO determinations. These results were not evaluated using the SAM/1A methodology because the MEG values are specific to individual organic compounds which are not identified by Grav and TCO analysis.

5.1.2 Biological Test Analysis

The testing of industrial feed and waste streams for biological effects is needed to complement the physical and chemical data and to ensure that the assessment is comprehensive. Biological testing can provide an indication of toxicity and mutagenicity of substances to organisms that the other tests cannot. This is especially important when dealing with substances for which there is little available data on toxicity or when assessing complex mixtures where synergisms and antagonisms may alter the toxicity of the individual components. The use of biological assays in conjunction with other tests provides a better data base from which to prioritize streams relative to further study and/or control technology needs.

Biological test result evaluations are based on a subjective interpretation of the data in terms of low, moderate, or high effects for each test. Note that these interpretations are based on the biological responses of highly sensitive cellular as well as whole-organism cultures. The positive response of these indicator-type organisms or cells can be considered to be a worst case situation. Low or nondetectable effects indicate that the material will not have any adverse health or ecological effects. Moderate or high effects indicate that the material may be potentially hazardous and more rigorous testing should be initiated before an ultimate fate can be established.

The results of the water quality analyses performed on the three settling ponds are compared to the most stringent state effluent water regulations for eastern and midwestern states as stated in the Bureau of National Affairs, Environment Reporter State Water Laws. For those waste streams that could potentially enter the ground water (i.e., runoff flows and solids leachates), the applicable water quality parameters were compared to the Extraction Procedure Toxicity Concentrations of the Resource Conservation and Recovery Act.

5.2 TEST RESULTS SUMMARY AND ANALYSIS

5.2.1 Chemical and Biological Test Results

The chemical and biological test results from the Source Test and Evaluation program at coal preparation plant No. 2 are presented for the following:

- Fugitive air emissions.
- Liquid waste streams.
- Solid waste streams.
- Organics.
- Additional chemical test results.

5.2.2 Fugitive Air Emissions

Fugitive Total Suspended Particulates (TSP) and vapors were sampled downwind from the ROM coal storage pile and the rotary breaker. Samples were also taken downwind and upwind of the coal preparation facility. Fugitive particulates were sampled using Hi-Vols to obtain ambient concentrations and with cascade impactors to determine particle size distribution. The particulates were analyzed for chemical content using SSMS and were studied for particulate morphology. The vapors captured by the XAL-2 resin were also analyzed using SSMS. Both the particulates and vapors were analyzed for total organic content. Additionally, biological assessments were performed on both the particulate matter (i.e., Ames assay and RAM) and the fugitive vapors (i.e., Ames assay and CHO clonal assay).

Table 5-1 presents the ambient TSP and TCO + Grav concentrations measured from the Hi-Vols and XAD-2 resins, respectively. Note that all samples were taken within the plant boundaries. The total TSP concentrations and the concentration of particles less than 15 $\mu g/m^3$ are the highest around the rotary breaker and the ROM coal pile. This is expected because of the continual coal handling activity in those areas. For comparison purposes, the 24-hour primary and secondary ambient air quality standards for TSP are 260 and 150 $\mu g/m^3$, respectively.

The TCO + Grav for all sources sampled were considerably below the three-hour total hydrocarbon ambient air quality standard of 160 $\mu g/m^3$. The TCO + Grav concentrations, however, are highest downwind and upwind from the preparation plant. If one assumes that the upwind value of 90 $\mu g/m^3$ represents background concentrations, then the preparation plant is contributing approximately 40 $\mu g/m^3$ of gaseous organic matter to the environment, far below the ambient quality standard.

The total discharge severity values for all four fugitive emission sources are very similar and are summarized in Table 5-2. The health and ecological TDS values for all four fugitive particulate samples are less than or equal to 1×10^{-2}. Biological tests for fugitive emissions are summarized in Tables 5-3 and 5-4. A composite sample of ROM coal storage

TABLE 5-1. SUMMARY OF TOTAL SUSPENDED PARTICULATE AND TCO + GRAV (VAPOR) MEASUREMENTS

Sample Source	Distance from Source	No. of Hrs. Measured	Total TSP Concentration	Particle Size $<15\mu$	TCO + GRAV Concentration
Rotary Breaker	200 m	20	305 $\mu g/m^3$	110.1 $\mu g/m^3$	10 $\mu g/m^3$
ROM Coal Pile	100 m	20	218 $\mu g/m^3$	91.1 $\mu g/m^3$	20 $\mu g/m^3$
Upwind (ambient)	300 m (from preparation plant)	20	76.1 $\mu g/m^3$	64.7 $\mu g/m^3$	90 $\mu g/m^3$
Downwind	600 m (from preparation plant)	21	146 $\mu g/m^3$	57.1 $\mu g/m^3$	130 $\mu g/m^3$

TABLE 5-2. SUMMARY OF TOTAL DISCHARGE SEVERITY VALUES FOR FUGITIVE PARTICULATE AND VAPOR DISCHARGES

Fugitive Discharge Source	Health TDS	Ecological TDS	Compounds Found From Chemical Analysis to be >1 x 10^1	
			Health	Ecological
Particulates				
ROM Coal Storage Pile	1E-2	2E-3	--	--
Rotary Breaker	1E-2	6E-3	--	--
Downwind - Entire Facility	1E-2	2E-2	--	--
Upwind - Ambient Blank	1E-2	3E-3	--	--
Vapors				
ROM Coal Storage Pile	8E0	3E-1	Cr	--
Rotary Breaker	7E0	1E-1	(Cr, Ni)	--
Downwind - Entire Facility	1E1	9E-1	(Cr, Ni)	--
Upwind - Ambient Blank	8E0	3E-1	Cr	--

( ) Analytical results indicate possible contamination.

TABLE 5-3. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR COMPOSITE OF ROM COAL STORAGE PILE, ROTARY BREAKER, AND DOWNWIND FUGITIVE PARTICULATES

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
10^3 - 10^4	No discharge severity values greater than 1.	No discharge severity values greater than 1.		
			Health	
10^2 - 10^3			Ames	Negative
10 - 10^2			RAM(EC_{50})	251 μℓ/mℓ;moderate effect (% phagocytosis) 208 μℓ/mℓ (nmol ATP/well)
			Ecological	
1 - 10			Not conducted.	

TABLE 5-4. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR UPWIND FUGITIVE PARTICULATES

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	No discharge severity values greater than 1.	No discharge severity values greater than 1.		
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$			RAM(EC_{50})	>300 µℓ/mℓ; moderate effect (% phagocytosis) 251 µℓ/mℓ (nmol ATP/well)
			Ecological	
1 - 10			Not conducted.	

pile, rotary breaker and downwind fugitive particulates, and the upwind fugitive particulate sample produced a moderate effect when tested by the RAM assay.

Table 5-5 summarizes the SAM/1A evaluation results and bioassay results for the vapors. There were two individual elements (nickel and chromium) with DS values greater than one when compared to the health DMEG. However, the nickel concentration is greater in the XAD-2 resin blank than in the two waste streams, indicating contamination. The chromium concentrations may be associated with the nickel contamination. Another possibility is that very fine particles (<0.5 μ) are passing through the filter. As a result, the TDS for health ranges from 6 to 12. There were no ecological TDS values greater than one. These low TDS values are also reflected in the biological assessment results which showed no effects.

Tables 5-6 through 5-13 present the test results, the DMEG values, and discharge severity values for the individual inorganic elements in each of the particulate and vapor samples taken at the four locations.

5.2.3 Liquid Waste Streams

Samples of five liquid waste streams were taken at coal preparation plant No. 2, including fine refuse slurry, desilting pond water, transfer pond water, runoff pond water, and runoff from the ROM coal storage pile. Four additional waste stream samples were produced by filtering the fine refuse slurry, desilting pond water, transfer pond water,and the runoff pond water. Leachates were also generated from the solid samples and are discussed in Section 5.2.4.

The nine liquid waste streams were analyzed for inorganic chemical composition using both Inductively Coupled Argon Plasma (ICP) and Spark Source/Mass Spectrophotometer (SSMS) for extractable organics (except raw pond waters) and for biological response (except filtrates). The results of these analyses and the SAM/1A evaluation of the inorganic constituent results are presented below. Classical water quality parameter results and discussions are provided in Section 5.2.5.

TABLE 5-5. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR ROM COAL STORAGE PILE, ROTARY BREAKER, UPWIND, AND DOWNWIND VAPORS

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
10^3 - 10^4		No discharge severity values greater than 1.		
			Health	
10^2 - 10^3			Ames	Negative
10 - 10^2			CHO(EC_{50})	>600 μℓ/mℓ; nontoxic
			Ecological	
1 - 10	Cr, Ni*		Not conducted.	

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* Nickel found only in rotary breaker and downwind vapors. Results indicate that the nickel concentration may be a result of contamination during analysis.

TABLE 5-6. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROM COAL PILE FUGITIVE PARTICULATES

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>0.03	>6E-6	N	a	N	39. Gallium	0.001	2E-7	N	g	N
47. Ammonia	NR					44. Germanium	<0.00006	<1E-7	N	a	N
50. Antimony	0.0006	1E-6	N	a	N	80. Gold	<0.00003	N	N	N	N
49. Arsenic	0.0002	1E-4	N	c	N	64. Hafnium	<0.0003	N	N	N	N
36. Barium	0.01	3E-5	N	a	N	Holmium	<0.0003	N	N	N	N
32. Beryllium	<0.00003	<2E-5	N	a	N	59. Iodine	0.001	N	N	N	N
51. Bismuth	<0.00009	<2E-7	N	a	N	Iridium	<0.00003	N	N	N	N
37. Boron	<0.03	9E-6	N	a	N	72. Iron	0.2	N	N	N	N
58. Bromine	0.006	N	N	N	N	84. Lanthanum	0.003	N	N	N	N
82. Cadmium	<0.0002	<2E-5	N	a	N	46. Lead	0.01	9E-5	N	a	N
34. Calcium	*					27. Lithium	0.0001	5E-6	N	a	N
84. Cerium	0.003	N	N	N	N	Lutecium	<0.00006	N	N	N	N
31. Cesium	<0.003	N	N	N	N	33. Magnesium	*				
57. Chlorine	0.006	N	N	N	N	71. Manganese	0.03	6E-6	N	a	N
68. Chromium	0.009	9E-3	N	c	N	83. Mercury	0.0004	7E-6	4E-5	c	c
74. Cobalt	<0.0006	<1E-5	N	a	N	69. Molybdenum	0.0003	6E-8	N	a	N
78. Copper	0.01	7E-5	N	a	N	84. Neodymium	0.003	N	N	N	N
84. Dysprosium	0.0006	N	N	N	N	76. Nickel	0.0009	6E-5	N	f	N
Erbium	<0.0001	N	N	N	N	66. Niobium	0.001	N	N	N	N
Europium	<0.0002	N	N	N	N	Osmium	<0.00003	N	N	N	N
56. Fluorine	<0.06	N	N	N	N	Palladium	<0.00003	N	N	N	N
Gadolinium	<0.0003	N	N	N	N	48. Phosphorus	>0.3	>3E-3	N	a	N

* Major component of both the sample and the blank.

TABLE 5-6. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROM COAL PILE FUGITIVE PARTICULATES

(Continued)

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.00003	N	N	N	N	67. Tantalum	<0.00003	N	N	N	N
29. Potassium	*					55. Tellurium	<0.00003	<3E-7	N	a	N
84. Praseodymium	0.001	N	N	N	N	Terbium	<0.0001	N	N	N	N
Rhenium	<0.00003	N	N	N	N	41. Thallium	<0.00003	<3E-7	N	a	N
75. Rhodium	<0.00003	N	N	N	N	85. Thorium	<0.001	<1E-4	N	h	N
30. Rubidium	0.006	N	N	N	N	Thulium	<0.00003	N	N	N	N
73. Ruthenium	<0.00003	N	N	N	N	45. Tin	<0.0002	N	N	N	N
84. Samarium	0.0006	N	N	N	N	62. Titanium	0.3	4E-5	N	a	N
60. Scandium	<0.0001	<3E-9	N	g	N	70. Tungsten	<0.0002	<2E-7	N	a	N
54. Selenium	<0.0003	<2E-6	N	N	N	85. Uranium	<0.001	<1E-4	N	h	N
43. Silicon	*					65. Vanadium	0.002	5E-6	2E-3	a	a
79. Silver	<0.00006	<6E-6	N	N	N	Ytterbium	<0.0003	N	N	N	N
28. Sodium	>0.09	N	N	N	N	61. Yttrium	0.0008	N	N	N	N
35. Strontium	0.02	7E-6	N	g	N	81. Zinc	0.007	2E-6	N	a	N
63. Elemental Sulfur	>0.2	N	N	N	N	63. Zirconium	0.009	N	N	N	N
						Total Discharge Severity =		1.3E-2	2.0E-3		

* Major component of both the sample and the blank.

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-7. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROTARY BREAKER FUGITIVE PARTICULATES

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>0.02	>5E-6	N	a	N	39. Gallium	0.002	4E-7	N	q	N
47. Ammonia	NR					44. Germanium	<0.00006	<1E-7	N	N	N
50. Antimony	<0.00009	<2E-7	N	a	N	80. Gold	<0.00003	N	N	N	N
49. Arsenic	0.002	1E-3	N	c	N	64. Hafnium	<0.00003	N	N	N	N
36. Barium	0.01	3E-5	N	a	N	Holmium	<0.0001	N	N	N	N
32. Beryllium	<0.00003	<2E-5	N	a	N	59. Iodine	0.0006	N	N	N	N
51. Bismuth	<0.00003	<7E-8	N	a	N	Iridium	<0.00003	N	N	N	N
37. Boron	<0.03	<9E-6	N	a	N	72. Iron	>0.2	N	N	N	N
58. Bromine	<0.006	N	N	N	N	84. Lanthanum	0.006	N	N	N	N
82. Cadmium	<0.00009	<9E-6	N	a	N	46. Lead	0.002	1E-5	N	a	N
34. Calcium	*					27. Lithium	0.0007	3E-5	N	a	N
84. Cerium	0.003	N	N	N	N	Lutecium	<0.00003	N	N	N	N
31. Cesium	<0.0003	N	N	N	N	33. Magnesium	*				
57. Chlorine	0.06	N	N	N	N	71. Manganese	0.03	6E-6	N	c	N
68. Chromium	<0.009	<9E-3	N	N	N	83. Mercury	0.0004	8E-6	4E-5	c	c
74. Cobalt	0.0006	1E-5	N	N	N	69. Molybdenum	<0.001	<2E-7	N	a	N
78. Copper	0.003	1E-5	N	N	N	84. Neodymium	0.0006	N	N	N	N
84. Dysprosium	<0.0002	N	N	N	N	76. Nickel	0.003	2E-4	N	f	N
Erbium	<0.00009	N	N	N	N	66. Niobium	0.001	N	N	N	N
Europium	<0.00006	N	N	N	N	Osmium	<0.00003	N	N	N	N
56. Fluorine	>0.06	N	N	N	N	Palladium	<0.00003	N	N	N	N
Gadolinium	<0.0003	N	N	N	N	48. Phosphorus	0.08	8E-4	N	a	N

* Major component of both the sample and the blank.

TABLE 5-7. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROTARY BREAKER FUGITIVE PARTICULATES

(Continued)

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	0.00003	N	N	N	N	67. Tantalum	<0.00003	N	N	N	N
29. Potassium	*					55. Tellurium	<0.00003	<3E-7	N	a	N
84. Praseodymium	0.0006	N	N	N	N	Terbium	<0.00006	N	N	N	N
Rhenium	<0.00003	N	N	N	N	41. Thallium	<0.00003	<3E-7	N	a	N
75. Rhodium	<0.00003	N	N	N	N	85. Thorium	<0.0009	<1E-4	N	h	N
30. Rubidium	0.003	N	N	N	N	Thulium	<0.00003	N	N	N	N
73. Ruthenium	<0.00003	N	N	N	N	45. Tin	<0.00006	N	N	N	N
84. Samarium	0.0006	N	N	N	N	62. Titanium	>0.3	>5E-5	N	a	N
60. Scandium	0.0006	1E-8	N	N	N	70. Tungsten	<0.00003	<3E-8	N	N	N
54. Selenium	<0.0003	<2E-6	N	a	N	85. Uranium	<0.0002	<2E-5	N	h	N
43. Silicon	*					65. Vanadium	0.006	1E-5	6E-3	a	a
79. Silver	<0.0001	<3E-6	N	N	N	Ytterbium	<0.00003	N	N	N	N
28. Sodium	>0.06	N	N	N	N	61. Yttrium	0.0008	N	N	N	N
35. Strontium	0.008	3E-6	N	g	N	81. Zinc	0.01	3E-6	N	a	N
53. Elemental Sulfur	>0.1	N	N	N	N	63. Zirconium	0.006	N	N	N	N

Total Discharge Severity = 1.1E-2 6.0E-3

* Major component of both the sample and the blank.

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-8. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR UPWIND FUGITIVE PARTICULATES

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>0.03	>5E-6	N	a	N	39. Gallium	0.0009	2E-7	N	g	N
47. Ammonia	NR					44. Germanium	<0.00006	<1E-7	N	a	N
50. Antimony	<0.0002	<4E-7	N	a	N	80. Gold	<0.00003	N	N	N	N
49. Arsenic	0.001	6E-4	N	c	N	64. Hafnium	<0.00003	N	N	N	N
36. Barium	0.1	2E-4	N	a	N	Holmium	<0.0009	N	N	N	N
32. Beryllium	<0.00003	<2E-5	N	a	N	59. Iodine	0.001	N	N	N	N
51. Bismuth	<0.00003	<7E-8	N	a	N	Iridium	<0.00003	N	N	N	N
37. Boron	<0.03	<9E-6	N	a	N	72. Iron	>0.2	N	N	N	N
58. Bromine	0.003	N	N	N	N	84. Lanthanum	0.006	N	N	N	N
82. Cadmium	<0.00009	<9E-6	N	a	N	46. Lead	0.005	3E-5	N	a	N
34. Calcium	*					27. Lithium	0.0001	5E-6	N	a	N
84. Cerium	0.001	N	N	N	N	Lutecium	<0.00003	N	N	N	N
31. Cesium	<0.0002	N	N	N	N	33. Magnesium	*				
57. Chlorine	0.03	N	N	N	N	71. Manganese	0.03	6E-6	N	N	N
68. Chromium	<0.009	<9E-3	N	c	N	83. Mercury	0.00006	1E-6	6E-6	c	c
74. Cobalt	<0.002	<4E-6	N	a	N	69. Molybdenum	<0.001	<2E-7	N	a	N
78. Copper	0.009	4E-5	N	a	N	84. Neodymium	<0.0003	N	N	N	N
84. Dysprosium	<0.0001	N	N	N	N	76. Nickel	0.0009	6E-5	N	f	N
Erbium	<0.00006	N	N	N	N	66. Niobium	0.001	N	N	N	N
Europium	<0.00006	N	N	N	N	Osmium	<0.00003	N	N	N	N
56. Fluorine	<0.03	N	N	N	N	Palladium	<0.00003	N	N	N	N
Gadolinium	<0.0001	N	N	N	N	48. Phosphorus	0.08	8E-4	N	a	N

*Major component of both the sample and the blank.

TABLE 5-8. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR UPWIND FUGITIVE PARTICULATES
(Continued)

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.00003	N	N	a	N	67. Tantalum	<0.00003	N	N	N	N
29. Potassium	*					55. Tellurium	<0.00006	<6E-7	N	a	N
84. Praseodymium	0.0003	N	N	N	N	Terbium	<0.00006	N	N	N	N
Rhenium	<0.00003	N	N	N	N	41. Thallium	<0.00003	<3E-7	N	a	N
75. Rhodium	<0.00003	N	N	N	N	85. Thorium	<0.0006	<7E-5	N	h	N
30. Rubidium	0.002	N	N	N	N	Thulium	<0.00003	N	N	N	N
73. Ruthenium	<0.00003	N	N	N	N	45. Tin	<0.0001	N	N	N	N
84. Samarium	<0.0003	N	N	N	N	62. Titanium	0.1	2E-5	N	a	N
60. Scandium	<0.0001	<3E-9	N	g	N	70. Tungsten	<0.00003	<3E-8	N	a	N
54. Selenium	<0.0006	<3E-6	N	a	N	85. Uranium	<0.0003	<3E-5	N	h	N
43. Silicon	*					65. Vanadium	0.003	6E-6	3E-3	a	a
79. Silver	<0.00003	<3E-6	N	a	N	Ytterbium	<0.00003	N	N	N	N
28. Sodium	>0.06	N	N	N	N	61. Yttrium	0.0008	N	N	N	N
35. Strontium	0.01	4E-6	N	g	N	81. Zinc	0.007	2E-6	N	a	N
53. Elemental Sulfur	>0.1	N	N	N	N	63. Zirconium	0.003	N	N	N	N

Total Discharge Severity = 1.1E-2 3.0E-3

* Major component of both the sample and the blank.

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-9. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DOWNWIND FUGITIVE PARTICULATES

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>0.02	>4E-6	N	a	N	39. Gallium	0.0008	2E-7	N	g	N
47. Ammonia	NR					44. Germanium	<0.00006	<1E-7	N	a	N
50. Antimony	<0.00009	<2E-7	N	a	N	80. Gold	<0.00003	N	N	N	N
49. Arsenic	0.001	5E-4	N	c	N	64. Hafnium	<0.00003	N	N	N	N
36. Barium	0.1	2E-4	N	a	N	Holmium	<0.00006	N	N	N	N
32. Beryllium	<0.00003	<1E-5	N	a	N	59. Iodine	0.0003	N	N	N	N
51. Bismuth	<0.00003	<7E-8	N	a	N	Iridium	<0.00003	N	N	N	N
37. Boron	0.03	8E-6	N	a	N	72. Iron	>0.2	N	N	N	N
58. Bromine	<0.006	N	N	N	N	84. Lanthanum	0.002	N	N	N	N
82. Cadmium	<0.0002	<2E-5	N	a	N	46. Lead	0.01	7E-5	N	a	N
34. Calcium	*					27. Lithium	0.0007	3E-5	N	a	N
84. Cerium	0.003	N	N	N	N	Lutecium	<0.00003	N	N	N	N
31. Cesium	<0.0001	N	N	N	N	33. Magnesium	*				N
57. Chlorine	0.03	N	N	N	N	71. Manganese	0.02	4E-6	N	a	N
68. Chromium	<0.009	<9E-3	N	c	N	83. Mercury	0.00006	1E-6	6E-6	c	c
74. Cobalt	<0.0002	<3E-6	N	a	N	69. Molybdenum	<0.001	<2E-7	N	a	N
78. Copper	0.005	3E-5	N	a	N	84. Neodymium	0.0006	N	N	N	N
84. Dysprosium	<0.0002	N	N	N	N	76. Nickel	0.008	6E-4	N	f	N
Erbium	<0.00006	N	N	N	N	66. Niobium	0.001	N	N	N	N
Europium	<0.00006	N	N	N	N	Osmium	<0.00003	N	N	N	N
56. Fluorine	≈0.1	N	N	N	N	Palladium	<0.00003	N	N	N	N
Gadolinium	<0.0001	N	N	N	N	48. Phosphorus	0.07	7E-4	N	a	N

* Major component of both the sample and the blank.

TABLE 5-9. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DOWNWIND FUGITIVE PARTICULATES

(Continued)

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.00003	N	N	N	N	67. Tantalum	<0.00003	N	N	N	N
29. Potassium	*					55. Tellurium	<0.00003	<3E-7	N	a	N
84. Praseodymium	0.0005	N	N	N	N	Terbium	<0.00006	N	N	N	N
Rhenium	<0.00003	N	N	N	N	41. Thallium	<0.00003	<3E-7	N	a	N
75. Rhodium	<0.00003	N	N	N	N	85. Thorium	<0.0009	<1E-4	N	h	N
30. Rubidium	0.006	N	N	N	N	Thulium	<0.00003	N	N	N	N
73. Ruthenium	<0.00003	N	N	N	N	45. Tin	<0.0002	N	N	N	N
84. Samarium	<0.00006	N	N	N	N	62. Titanium	0.3	5E-5	N	a	N
60. Scandium	<0.0006	<1E-8	N	g	N	70. Tungsten	<0.00003	<3E-8	N	a	N
54. Selenium	<0.0003	<1E-6	N	a	N	85. Uranium	<0.0006	<6E-5	N	h	N
43. Silicon	*					65. Vanadium	0.02	3E-4	2E-2	a	a
79. Silver	<0.00003	<3E-6	N	a	N	Ytterbium	<0.00003	N	N	N	N
28. Sodium	>0.06	N	N	N	N	61. Yttrium	0.002	N	N	N	N
35. Strontium	0.02	6E-6	N	g	N	81. Zinc	0.0009	2E-7	N	a	N
53. Elemental Sulfur	>0.1	N	N	N	N	63. Zirconium	0.03	N	N	N	N

Total Discharge Severity = 1.2E-2 2.0E-2

* Major component of both the sample and the blank.

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-10. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROM COAL PILE VAPORS

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	<12	<2.3E-3	N	a	N	39. Gallium	<0.8	<2E-4	N	g	N
47. Ammonia	NR		N			44. Germanium	<0.8	<1E-3	N	a	N
50. Antimony	<0.8	<2E-3	N	a	N	80. Gold	<0.8	N	N	N	N
49. Arsenic	<0.8	<4E-1	N	c	N	64. Hafnium	<3	N	N	N	N
36. Barium	7	1E-2	N	a	N	Holmium	<0.8	N	N	N	N
32. Beryllium	<0.8	<4E-1	N	a	N	59. Iodine	8	N	N	N	N
51. Bismuth	<0.8	<2E-3	N	a	N	Iridium	<0.8	N	N	N	N
37. Boron	<0.8	<3E-4	N	a	N	72. Iron	54	N	N	N	N
58. Bromine	7	N	N	N	N	84. Lanthanum	<0.8	N	N	N	N
82. Cadmium	<0.9	<9E-2	N	a	N	46. Lead	7	4E-2	N	a	N
34. Calcium	8	N	N	N	N	27. Lithium	<0.4	<2E-2	N	a	N
84. Cerium	<0.8	N	N	N	N	Lutecium	<0.8	N	N	N	N
31. Cesium	12	N	N	N	N	33. Magnesium	93	1.5E-2	N	a	N
57. Chlorine	48	N	N	N	N	71. Manganese	0.7	1E-4	N	c	N
68. Chromium	<4	<4E0	N	c	N	83. Mercury	0.03	5E-4	3E-3	c	c
74. Cobalt	<0.7	<1E-2	N	a	N	69. Molybdenum	5	1E-3	N	a	N
78. Copper	8	4E-2	N	a	N	84. Neodymium	<0.8	N	N	N	N
84. Dysprosium	<0.8	N	N	N	N	76. Nickel	13	8.8E-1	N	f	N
Erbium	<0.8	N	N	N	N	66. Niobium	<0.8	N	N	N	N
Europium	<0.8		N	N	N	Osmium	<0.8	N	N	N	N
56. Fluorine	≈0.8	N	N	N	N	Palladium	<0.8	N	N	N	N
Gadolinium	<0.8	N	N	N	N	48. Phosphorus	7	7E-2	N	a	N

TABLE 5-10. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROM COAL PILE VAPORS
(Continued)

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.8	N	N	N	N	67. Tantalum	<0.8	N	N	N	N
29. Potassium	<239	<1.2E-1	N	a	N	55. Tellurium	<1	<1E-2	N	a	N
84. Praseodymium	<0.8	N	N	N	N	Terbium	<0.8	N	N	N	N
Rhenium	<0.8	N	N	N	N	41. Thallium	<0.8	<8E-3	N	a	N
75. Rhodium	<0.8	N	N	N	N	85. Thorium	<8	<9E-1	N	h	N
30. Rubidium	<0.8	N	N	N	N	Thulium	<0.8	N	N	N	N
73. Ruthenium	<0.8	N	N	N	N	45. Tin	<0.8	N	N	N	N
84. Samarium	<0.8	N	N	N	N	62. Titanium	<4	<7E-4	N	a	N
60. Scandium	<1	<2E-5	N	g	N	70. Tungsten	<0.8	<8E-4	N	a	N
54. Selenium	13	6.6E-2	N	a	N	85. Uranium	<7	<7E-1	N	h	N
43. Silicon	73	N	N	N	N	65. Vanadium	<0.3	<5E-4	<3E-1	a	a
79. Silver	<0.8	<8E-2	N	a	N	Ytterbium	<0.8	N	N	N	N
28. Sodium	<3	N	N	N	N	61. Yttrium	<0.8	N	N	N	N
35. Strontium	<0.7	<2E-4	N	g	N	81. Zinc	9	2E-3	N	a	N
53. Elemental Sulfur	86	N	N	N	N	63. Zirconium	<20	N	N	N	N
						Total Discharge Severity =		7.9E0	3.0E-1		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-11. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROTARY BREAKER VAPORS

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	<12	<2.2E-3	N	a	N	39. Gallium	<0.3	<5E-5	N	g	N
47. Ammonia	NR					44. Germanium	<0.3	<5E-4	N	a	N
50. Antimony	<0.3	<5E-4	N	a	N	80. Gold	<0.3	N	N	N	N
49. Arsenic	<0.3	<1E-1	N	c	N	64. Hafnium	<3	N	N	N	N
36. Barium	1	3E-3	N	a	N	Holmium	<0.3	N	N	N	N
32. Beryllium	<0.3	<1E-1	N	a	N	59. Iodine	<0.4	N	N	N	N
51. Bismuth	<0.3	<6E-4	N	a	N	Iridium	<0.3	N	N	N	N
37. Boron	<0.1	<4E-5	N	a	N	72. Iron	<28	N	N	N	N
58. Bromine	<0.6	N	N	N	N	84. Lanthanum	<0.3	N	N	N	N
82. Cadmium	<0.9	<9E-2	N	a	N	46. Lead	<0.3	<2E-3	N	a	N
34. Calcium	<93	N	N	N	N	27. Lithium	<0.4	<2E-2	N	a	N
84. Cerium	<0.3	N	N	N	N	Lutecium	<0.3	N	N	N	N
31. Cesium	<1	N	N	N	N	33. Magnesium	<6	<1E-3	N	a	N
57. Chlorine	<10	N	N	N	N	71. Manganese	<0.6	<1E-4	N	c	N
68. Chromium	<4	<4E0	N	c	N	83. Mercury	0.04	9E-4	4E-3	c	c
74. Cobalt	<0.5	<1E-2	N	a	N	69. Molybdenum	<4	<8E-4	N	a	N
78. Copper	<4	<2E-2	N	a	N	84. Neodymium	<0.3	N	N	N	N
84. Dysprosium	<0.3	N	N	N	N	76. Nickel	<21	<1.4E0	N	N	N
Erbium	<0.3	N	N	N	N	66. Niobium	<0.3	N	N	N	N
Europium	<0.3	N	N	N	N	Osmium	<0.3	N	N	N	N
56. Fluorine	≈0.3	N	N	N	N	Palladium	<0.3	N	N	N	N
Gadolinium	<0.3	N	N	N	N	48. Phosphorus	<22	<2.2E-1	N	a	N

TABLE 5-11. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROTARY BREAKER VAPORS (Continued)

MEG Category	Estimated Concentration (µg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc) Health	Ecological	Basis for Mate Value Health	Ecological	MEG Category	Estimated Concentration (µg/m³)	(Estimated Conc/ DMEG Conc) Health	Ecological	Basis for Mate Value Health	Ecological
77. Platinum	<0.8	N	N	N	N	67. Tantalum	<0.3	N	N	N	N
29. Potassium	<232	<1.2E-1	N	a	N	55. Tellurium	<0.3	<3E-3	N	a	N
84. Praseodymium	<0.3	N	N	N	N	Terbium	<0.3	N	N	N	N
Rhenium	<0.3	N	N	N	N	41. Thallium	<0.3	<3E-3	N	a	N
75. Rhodium	<0.3	N	N	N	N	85. Thorium	<3	<3E-1	N	h	N
30. Rubidium	<0.3	N	N	N	N	Thulium	<0.3	N	N	N	N
73. Ruthenium	<0.3	N	N	N	N	45. Tin	<0.3	N	N	N	N
84. Samarium	<0.3	N	N	N	N	62. Titanium	10	1.7E-3	N	a	N
60. Scandium	<0.1	<2E-6	N	g	N	70. Tungsten	<0.3	<3E-4	N	a	N
54. Selenium	<0.3	<1E-3	N	a	N	85. Uranium	<3	<3E-1	N	a	N
43. Silicon	<44	N	N	N	N	65. Vanadium	<0.1	<3E-4	<1E-1	a	a
79. Silver	<0.3	<3E-2	N	a	N	Ytterbium	<0.3	N	N	N	N
28. Sodium	<1	N	N		N	61. Yttrium	<0.3	N	N	N	N
35. Strontium	<0.3	<9E-5	N	g	N	81. Zinc	<5	<1E-3	N	a	N
53. Elemental Sulfur	<21	N	N	N	N	63. Zirconium	<19	N	N	N	N

Total Discharge Severity = 6.7E0 1.0E-1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-12. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR UPWIND VAPORS

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	212	4.1 E-2	N	a	N	39. Gallium	<0.6	<1 E-4	N	g	N
47. Ammonia	NR					44. Germanium	<0.6	<1 E-3	N	a	N
50. Antimony	<0.6	<1 E-3	N	a	N	80. Gold	<0.6	N	N	N	N
49. Arsenic	<0.6	<3 E-1	N	c	N	64. Hafnium	<3	N	N	N	N
36. Barium	<3	<6 E-3	N	a	N	Holmium	<0.6	N	N	N	N
32. Beryllium	<0.6	<3 E-1	N	a	N	59. Iodine	3	N	N	N	N
51. Bismuth	<0.6	<1 E-1	N	a	N	Iridium	<0.6	N	N	N	N
37. Boron	<0.6	<2 E-4	N	a	N	72. Iron	<33	N	N	N	N
58. Bromine	5	N	N	N	N	84. Lanthanum	<0.6	N	N	N	N
82. Cadmium	<1	<1 E-1	N	a	N	46. Lead	<0.6	<4 E-3	N	a	N
34. Calcium	<108	N	N	N	N	27. Lithium	0.3	1 E-2	N	a	N
84. Cerium	<0.6	N	N	N	N	Lutecium	<0.6	N	N	N	N
31. Cesium	26	N	N	N	N	33. Magnesium	<8	<1 E-3	N	a	N
57. Chlorine	39	N	N	N	N	71. Manganese	0.2	3 E-5	N	c	N
68. Chromium	<5	<5 E0	N	c	N	83. Mercury	0.05	9 E-4	5 E-3	c	c
74. Cobalt	<0.3	<6 E-3	N	a	N	69. Molybdenum	3	6 E-4	N	a	N
78. Copper	32	1.6 E-1	N	a	N	84. Neodymium	<0.6	N	N	N	N
84. Dysprosium	<0.6	N	N	N	N	76. Nickel	3	2 E-1	N	f	N
Erbium	<0.6	N	N	N	N	66. Niobium	<0.6	N	N	N	N
Europium	<0.6	N	N	N	N	Osmium	<0.6	N	N	N	N
56. Fluorine	≈0.3	N	N	N	N	Palladium	<0.6	N	N	N	N
Gadolinium	<0.6	N	N	N		48. Phosphorus	3	3 E-2	N	a	N

TABLE 5-12. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR UPWIND VAPORS (Continued)

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological
77. Platinum	<0.9	N	N	N	N
29. Potassium	<271	<1.4 E-1	N	a	N
84. Praseodymium	<0.6	N	N	N	N
Rhenium	<0.6	N	N	N	N
75. Rhodium	<0.6	N	N	N	N
30. Rubidium	<0.6	N	N	N	N
73. Ruthenium	<0.6	N	N	N	N
84. Samarium	<0.6	N	N	N	N
60. Scandium	<0.8	<1 E-5	N	g	N
54. Selenium	<0.6	<3 E-3	N	a	N
43. Silicon	42	N	N	N	N
79. Silver	<0.6	<6 E-2	N	a	N
28. Sodium	<2	N	N	N	N
35. Strontium	<0.6	<2 E-4	N	g	N
53. Elemental Sulfur	<24	N	N	N	N
67. Tantalum	<0.6	N	N	N	N
55. Tellurium	<0.6	<6 E-3	N	a	N
Terbium	<0.6	N	N	N	N
41. Thallium	<6	<6 E-2	N	a	N
85. Thorium	<6	<7 E-1	N	h	N
Thulium	<0.6	N	N	N	N
45. Tin	<0.6	N	N	N	N
62. Titanium	3	5 E-4	N	a	N
70. Tungsten	<0.6	<6 E-4	N	a	N
85. Uranium	<5	<5 E-1	N	h	N
65. Vanadium	<0.3	<6 E-4	<3 E-1	a	a
Ytterbium	<0.6	N	N	N	N
61. Yttrium	<0.6	N	N	N	N
81. Zinc	<6	<2 E-3	N	a	N
63. Zirconium	<23	N	N	N	N
Total Discharge Severity =		7.7E0	3.1E-1		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-13. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DOWNWIND VAPORS

MEG Category	Estimated Concentration ($\mu g/m^3$)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration ($\mu g/m^3$)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	24	4.7 E-3	N	a	N	39. Gallium	<0.3	<6 E-5	N	g	N
47. Ammonia	NR					44. Germanium	<0.3	<5 E-4	N	a	N
50. Antimony	<0.3	<5 E-4	N	a	N	80. Gold	<0.3	N	N	N	N
49. Arsenic	<0.3	<1 E-1	N	c	N	64. Hafnium	<3	N	N	N	N
36. Barium	28	5.6 E-2	N	a	N	Holmium	<0.3	N	N	N	N
32. Beryllium	<0.3	<1 E-1	N	a	N	59. Iodine	<0.4	N	N	N	N
51. Bismuth	<0.3	<6 E-4	N	a	N	Iridium	<0.3	N	N	N	N
37. Boron	<1	<3 E-4	N	a	N	72. Iron	278	N	N	N	N
58. Bromine	2	N	N	N	N	84. Lanthanum	<0.3	N	N	N	N
82. Cadmium	<0.9	<9 E-2	N	a	N	46. Lead	<3	<2 E-2	N	a	N
34. Calcium	74	N	N	N	N	27. Lithium	<0.4	<2 E-2	N	a	N
84. Cerium	<0.3	N	N	N	N	Lutecium	<0.3	N	N	N	N
31. Cesium	<1	N	N	N	N	33. Magnesium	326	5.4 E-2	N	a	N
57. Chlorine	55	N	N	N	N	71. Manganese	6	1 E-3	N	c	N
68. Chromium	9	9 E0	N	c	N	83. Mercury	0.04	8 E-4	4 E-3	c	c
74. Cobalt	<0.3	<5 E-3	N	a	N	69. Molybdenum	4	8 E-4	N	a	N
78. Copper	13	6.4 E-2	N	a	N	84. Neodymium	<0.3	N	N	N	N
84. Dysprosium	<0.3	N	N	N	N	76. Nickel	15	1.0 E0	N	f	N
Erbium	<0.3	N	N	N	N	66. Niobium	<0.3	N	N	N	N
Europium	<0.3	N	N	N	N	Osmium	<0.3	N	N	N	N
56. Fluorine	≈10	N	N	N	N	Palladium	<0.3	N	N	N	N
Gadolinium	<0.3	N	N	N	N	48. Phosphorus	<22	<2.2 E-1	N	a	N

TABLE 5-13. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DOWNWIND VAPORS
(Continued)

MEG Category	Estimated Concentration (μg/m³)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/m³)	(Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.8	N	N	N	N	67. Tantalum	<0.3	N	N	N	N
29. Potassium	945	4.7 E-1	N	a	N	55. Tellurium	<0.3	<3 E-3	N	a	N
84. Praseodymium	<0.3	N	N	N	N	Terbium	<0.3	N	N	N	N
Rhenium	<0.2	N	N	N	N	41. Thallium	<0.3	<3 E-3	N	a	N
75. Rhodium	<0.3	N	N	N	N	85. Thorium	<3	<3 E-1	N	h	N
30. Rubidium	<0.3	N	N	N	N	Thulium	<0.3	N	N	N	N
73. Ruthenium	<0.3	N	N	N	N	45. Tin	<0.3	N	N	N	N
84. Samarium	<0.3	N	N	N	N	62. Titanium	29	4.9 E-3	N	a	N
60. Scandium	<0.1	<2 E-6	N	g	N	70. Tungsten	<0.3	<3 E-4	N	a	N
54. Selenium	<0.8	<4 E-3	N	a	N	85. Uranium	<3	<3 E-1	N	N	N
43. Silicon	199	N	N	N	N	65. Vanadium	<0.9	<2 E-3	<9 E-1	a	a
79. Silver	<0.3	<3 E-2	N	a	N	Ytterbium	<0.3	N	N	N	N
28. Sodium	<0.9	N	N	N	N	61. Yttrium	<0.3	N	N	N	N
35. Strontium	11	3.8 E-3	N	g	N	81. Zinc	14	3.5 E-3	N	a	N
53. Elemental Sulfur	19	N	N	N	N	63. Zirconium	<19	N	N	N	N

Total Discharge Severity = 1.2 E1 9.0 E-1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

5.2.3.1 ROM Coal Storage Pile Runoff--

Table 5-14 summarizes the SAM/1A evaluation of the inorganic constituents and the bioassay test results. As indicated, the health-based TDS, which has a value of 2, has no compound with a DS greater than or equal to one. The ecological-based TDS is 16 with ammonia, cadmium, lead, nickel, silver, and selenium having DS values equal to or greater than one. The individual DS values for all the constituents are shown on Table 5-15.

The ROM coal pile runoff biological tests were health related only. The Ames assay was negative and the CHO clonal assay showed nontoxic cellular effects (EC_{50} is >600 μl/ml).

The ROM coal pile runoff sample consisted of no detectable chromatographable or gravimetrically determined organics.

5.2.3.2 Desilting Pond Water Filtrate--

The TDS values for this water, as determined by the SAM/1A evaluation, are 1.4 (health based) and 8 (ecological based). Cadmium, ammonia, and manganese were the most significant contributors, with DS values equal to or greater than one; as indicated in Tables 5-16 and 5-17.

Additionally, Table 5-16 shows the results of the biological tests performed on unfiltered desilting pond water. The health-related costs reveal a negative response to the Ames assay, a moderate effect in the CHO clonal assay (EC_{50} of 255 μl/ml), and the Rodent Acute test showed a nontoxic response (LD_{50} of 10 g/kg). The ecological-related bioassay tests for desilting pond water showed low or nondetectable effects on fish and invertebrates, but moderate effects on algae. More specifically, 50 percent of the algae population (EC_{50}) was affected in test media containing 11.0 percent, 15.0 percent, and 10.5 percent concentrations of sample for 12-, 17-, and 21-day exposures, respectively.

The TCO and Grav results based on a filtered sample were 300 μg/ℓ. The only measurable value was from the gravimetric analysis.

5.2.3.3 Transfer Pond Water Filtrate--

The SAM/1A evaluation results for this pond are summarized in Tables 5-18 and 5-19. The health-based TDS value is approximately one with no

TABLE 5-14. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR ROM COAL STORAGE PILE RUNOFF

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	No discharge severity values greater than 1.			
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$			CHO(EC_{50})	>600 µℓ/mℓ; nontoxic
			Ecological	
1 - 10		Cd, Ni, (Ag). Se	Not conducted.	

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*The chemical results are a combination of ICP and spark source analyses.

( )Analytical results indicate possible contamination.

TABLE 5-15. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROM COAL PILE RUNOFF

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	130	1.6E-3	1.3E-1	a	c	33. Magnesium	51,500	5.7E-1	5.9E-1	a	e
50. Antimony	15	2.0E-3	7.5E-2	a	c	71. Manganese	20	8.0E-2	2.0E-1	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	38	7.6E-3	1.5E-2	c	c	69. Molybdenum	4	5E-5	6E-4	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	10	4.3E-2	1.0E0	a	c
37. Boron	33	7.0E-4	1.3E-3	a	c	29. Potassium	2,600	8.7E-2	6.0E-2	a	a
82. Cadmium	3	6E-2	3E0	c	c	54. Selenium	NR				
34. Calcium	99,000	N	N	N	N	79. Silver	<30	<1.2E-1	<6E0	c	c
68. Chromium	11	4.4E-2	4.4E-2	c	c	28. Sodium	34,800	N	N	N	N
74. Cobalt	2	3E-3	8E-3	c	c	35. Strontium	303	6.6E-3		g	N
78. Copper	3	6E-4	6E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	Interference			g		62. Titanium	3	3E-5	4E-3	a	e
72. Iron	152	N	N	N	N	65. Vanadium	26	1.0E-2	1.7E-1	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	10	3.0E-2	2.7E-2	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	100	<4E-2	<2E0	a	c	Palladium	<2	N	N	N	N
49. Arsenic	10	4E-2	2E-1	c	c	48. Phosphorus	100	N	N	N	N
51. Bismuth	<2	<3E-4	N	a	N	77. Platinum	<2	N	N	N	N
58. Bromine	90	N	N	N	N	84. Praseodymium	<2	N	N	N	N
84. Cerium	<2	N	N	N	N	Rhenium	<2	N	N	N	N
31. Cesium	<2	N	N	N	N	75. Rhodium	<2	N	N	N	N
57. Chlorine	500	N	N	N	N	30. Rubidium	2	N	N	N	N
84. Dysprosium	<2	N	N	N	N	73. Ruthenium	<2	N	N	N	N
Erbium	<2	N	N	N	N	84. Samarium	<2	N	N	N	N
Europium	<2	N	N	N	N	60. Scandium	≥3	≥4E-6	N	g	N
56. Fluorine	≥800	N	N	N	N	54. Selenium	30	6E-1	1E0	c	c
Gadolinium	<2	N	N	N	N	43. Silicon	3,000	N	N	N	N
44. Germanium	5	6E-4	N	a	N						
80. Gold	<2	N	N	N	N	53. Sulfur	>10,000	N	N	N	N
64. Hafnium	<2	N	N	N	N	67. Tantalum	<2	N	N	N	N
Holmium	<2	N	N	N	N	55. Tellurium	<2	<1E-3	N	a	N
59. Iodine	40	N	N	N	N	Terbium	<2	N	N	N	N
Iridium	<2	N	N	N	N	41. Thallium	<2	<1E-3	N	a	N
84. Lanthanum	<2	N	N	N	N	85. Thorium	<20	< 3E-4	<4E-2	h	N
Lutecium	<2	N	N	N	N	Thulium	<2	N	N	N	N
83. Mercury	0.2	2E-2	8E-4	c	c	70. Tungsten	10	7E-4	N	a	N
84. Neodymium	<2	N	N	N	N	85. Uranium	<20	<3E-4	<4E-2	h	c
66. Niobium	10	N	N	N	N	Ytterbium	<2	N	N	N	N
Osmium	<2	N	N	N	N	63. Zirconium	10	N	N	N	N

Total Discharge Severity = 2.0E0 1.6E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-16. SUMMARY OF CHEMICAL TEST RESULTS FOR DESILTING POND WATER FILTRATE AND BIOASSAY TEST RESULTS FOR DESILTING POND WATER (RAW)

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	No discharge severity values greater than 1.			
			Health	
$10^2 - 10^3$			Ames	Negative
			CHO(EC_{50})	255 µl/ml; nontoxic
$10 - 10^2$			Rodent Acute (LD_{50})	>10 g/kg; nontoxic
			Ecological	
			Aquatic Bioassay - Fish (LC_{50}, 96 hr.) >100%; nontoxic	
1 - 10		d, Mn	Aquatic Bioassay - Invertebrate (EC_{50}, 48 hr.) >100%; nontoxic	
			Aquatic Bioassay - Alga; moderate effect	
			● EC_{50}, 12-day	11.0%
			● EC_{50}, 17-day	15.0%
			● EC_{50}, 21-day	10.5%

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*Chemical results are a combination of ICP and spark source analyses.

TABLE 5-17. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DESILTING POND WATER FILTRATE

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	9,060	1.0E-1	1.0E-1	a	e
50. Antimony	20	2.7E-3	1.0E-1	a	c	71. Manganese	132	5.3E-1	1.3E0	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	68	1.4E-2	2.7E-2	c	c	69. Molybdenum	12	1.6E-4	1.7E-3	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	7	3E-2	7E-1	a	c
37. Boron	164	3.5E-3	6.6E-3	a	c	29. Potassium	4,200	1.4E-1	9.8E-2	a	a
82. Cadmium	<2	<4E-2	<2E0	c	c	54. Selenium	NR				
34. Calcium	26,900	N	N	N	N	79. Silver	2	8E-3	4E-1	c	c
68. Chromium	8	3E-2	3E-2	c	c	28. Sodium	55,400	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	320	7.0E-3	N	g	N
78. Copper	<1	<2E-4	<2E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	<10	<1.4E-4	N	g	N	62. Titanium	1	1E-5	1E-3	a	e
72. Iron	80	N	N	N	N	65. Vanadium	1	4E-4	7E-3	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	7	2E-2	2E-2	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	<100	<4E-2	<2E0	c	e	Palladium	<3	N	N	N	N
49. Arsenic	2	8E-3	4E-2	c	c	48. Phosphorus	60	N	N	N	N
51. Bismuth	<3	<5E-4	N	a	N	77. Platinum	<3	N	N	N	N
58. Bromine	100	N	N	N	N	84. Praseodymium	<3	N	N	N	N
84. Cerium	<3	N	N	N	N	Rhenium	<3	N	N	N	N
31. Cesium	<3	N	N	N	N	75. Rhodium	<3	N	N	N	N
57. Chlorine	50	N	N	N	N	30. Rubidium	3	N	N	N	N
84. Dysprosium	<3	N	N	N	N	73. Ruthenium	<3	N	N	N	N
Erbium	<3	N	N	N	N	84. Samarium	<3	N	N	N	N
Europium	<3	N	N	N	N	60. Scandium	≤4	≤5E-6	N	g	N
56. Fluorine	≈30	N	N	N	N	54. Selenium	<9	≤2E-1	≤4E-1	c	c
Gadolinium	<3	N	N	N	N	43. Silicon	1,000	N	N	N	N
44. Germanium	<3	<4E-4	N	a	N						
80. Gold	<3	N	N	N	N	53. Sulfur	8,000	N	N	N	N
64. Hafnium	<3	N	N	N	N	67. Tantalum	<3	N	N	N	N
Holmium	<3	N	N	N	N	55. Tellurium	<3	<2E-3	N	a	N
59. Iodine	20	N	N	N	N	Terbium	<3	N	N	N	N
Iridium	<3	N	N	N	N	41. Thallium	<3	<2E-3	N	a	N
84. Lanthanum	<3	N	N	N	N	85. Thorium	<30	<5E-4	<6E-2	h	N
Lutecium	<3	N	N	N	N	Thulium	<3	N	N	N	N
83. Mercury	<0.2	<2E-2	<8E-4	c	c	70. Tungsten	<3	<2E-4	N	a	N
84. Neodymium	<3	N	N	N	N	85. Uranium	<30	<5E-4	<6E-2	h	c
66. Niobium	<3	N	N	N	N	Ytterbium	<3	N	N	N	N
Osmium	<3	N	N	N	N	63. Zirconium	6	N	N	N	N
						Total Discharge Severity =		1.4E0	8.0E0		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-18. SUMMARY OF CHEMICAL TEST RESULTS FOR TRANSFER POND WATER FILTRATE AND BIOASSAY TEST RESULTS FOR TRANSFER POND WATER (RAW)

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	No discharge severity values greater than 1.			
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$				
			Ecological	
1 - 10		Ag, Mn	Not conducted	

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*The chemical results are a combination of ICP and spark source analyses.

TABLE 5-19. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR TRANSFER POND WATER FILTRATE

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	9,230	1.0E-1	1.1E-1	a	e
50. Antimony	<10	<1.3E-3	<5.0E-2	a	c	71. Manganese	127	5.1E-1	1.3E0	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	70	1.4E-2	2.8E-2	c	c	69. Molybdenum	8	1E-4	1E-3	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	<5	<2.2E-2	<5.0E-1	a	c
37. Boron	161	3.4E-3	6.4E-3	a	c	29. Potassium	4,600	1.5E-1	N	a	a
82. Cadmium	<2	<4E-2	<2E0	c	c	54. Selenium	NR				
34. Calcium	27,600	N	N	N	N	79. Silver	38	1.5E-1	7.6E0	c	c
68. Chromium	<2	<8E-3	<8E-3	c	c	28. Sodium	61,600	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	328	7.1E-3	N	g	
78. Copper	<1	<2E-4	<2E-2	c	c	45. Tin	<10	N	N	a	e
39. Gallium	<10	<1.4E-4	N	g	N	62. Titanium	<1	<1.0E-5	<1E-3	a	e
72. Iron	30	N	N	N	N	65. Vanadium	1	4E-4	7E-3	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	7	2E-2	2E-2	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	<100	<4E-2	<2E0	a	c	Palladium	<3	N	N	N	N
49. Arsenic	≤3	≤1E-2	≤6E-2	c	c	48. Phosphorus	200	N	N	N	N
51. Bismuth	<3	<5E-4	N	a	N	77. Platinum	<3	N	N	N	N
58. Bromine	200	N	N	N	N	84. Praseodymium	<3	N	N	N	N
84. Cerium	<3	N	N	N	N	Rhenium	<3	N	N	N	N
31. Cesium	<3	N	N	N	N	75. Rhodium	<3	N	N	N	N
57. Chlorine	700	N	N	N	N	30. Rubidium	10	N	N	N	N
84. Dysprosium	<3	N	N	N	N	73. Ruthenium	<3	N	N	N	N
Erbium	<3	N	N	N	N	84. Samarium	<3	N	N	N	N
Europium	<3	N	N	N	N	60. Scandium	≤4	≤5E-6	≤2E-1	g	N
56. Fluorine	≈5	N	N	N	N	54. Selenium	≤5	≤1E-2	≤2E-1	c	c
Gadolinium	<3	N	N	N	N	43. Silicon	2,000	N	N	N	N
44. Germanium	<3	<4E-4	N	a	N						
80. Gold	<3	N	N	N	N	53. Sulfur	>10,000	N	N	N	N
64. Hafnium	<3	N	N	N	N	67. Tantalum	<3	N	N	N	N
Holmium	<3			N	N	55. Tellurium	<3	<2E-3	N	a	N
59. Iodine	40	N	N	N	N	Terbium	<3	N	N	N	N
Iridium	<3	N	N	N	N	41. Thallium	<3	<2E-3	N	a	N
84. Lanthanum	<3	N	N	N	N	85. Thorium	<30	<5E-4	<6E-2	h	N
Lutecium	<3	N	N	N	N	Thulium	<3	N	N	N	N
83. Mercury	<0.2	<2E-2	<8E-4	c	c	70. Tungsten	<3	<2E-4	N	a	N
84. Neodymium	<3	N	N	N	N	85. Uranium	<20	<3E-4	<4E-2	h	c
66. Niobium	<3	N	N	N	N	Ytterbium	<3	N	N	N	N
Osmium	<3	N	N	N	N	63. Zirconium	<3	N	N	N	N
						Total Discharge Severity =		1.4E0	1.5E1		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

compounds having a DS value greater than one. The ecological-based TDS is 15 with ammonia, cadmium, silver, and manganese having DS values equal to or greater than one.

The health-related biological test performed on the unfiltered transfer pond water was the Ames test, which revealed a negative biological effect. No ecological bioassay testing was performed.

The TCO and Grav results for the transfer pond water filtrate were 400 µg/ℓ. The only measurable value was from the gravimetric analysis.

5.2.3.4 Runoff Pond Water Filtrate--

The SAM/1A evaluation results for this water are quite similar to the transfer pond water, with a health-based TDS of about 2 and an ecological-based TDS of about 18. As before, the most significant contributors to the ecological-based TDS are cadmium, ammonia, silver, lead, nickel, manganese, and zinc which have DS values equal to one (see Tables 5-20 and 5-21).

The bioassay results, also shown in Table 5-20, reveal that the health-related tests show low or nondetectable effects for the Ames assay, CHO clonal assay (EC_{50} > 600 µg/ml), and the Rodent Acute Tests (LD_{50} > 10 g/kg). The ecological-related bioassays showed nontoxic effects on fish (no effect after 96 hours in 100 percent sample concentration) and invertebrates (no effect seen after 48 hours in 100 percent sample concentration). Also, low or nondetectable effects were produced on algae with an EC_{50} of 34.0 percent, 56.5 percent, and 61.5 percent, for 12-, 17-, and 21-day exposures, respectively.

The total extractable organics value from a filtered sample was 300 µg/ℓ. Again, no TCO was detected.

5.2.3.5 Fine Refuse Slurry--

The TDS values for this slurry, as determined by the SAM/1A evaluation are 2.0 (health based) and 10 (ecological based). Similar to the pond waters, ammonia, lead, cadmium, and selenium have DS values equal to or greater than one, as indicated in Tables 5-22 and 5-23.

TABLE 5-20. SUMMARY OF CHEMICAL TEST RESULTS FOR RUNOFF POND WATER FILTRATE AND BIOASSAY TEST RESULTS FOR RUNOFF POND WATER (RAW)

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$			CHO(EC_{50})	>600 µl/ml; nontoxic
			Rodent Acute (LD_{50})	>10g/kg; nontoxic
			Ecological	
			Aquatic Bioassay - Fish (LC_{50}, 96 hr.)	100%; nontoxic
1 - 10	Mn	Ni, Mn, Cd, Pb, Ag, Zn	Aquatic Bioassay - Invertebrate (EC_{50}, 48 hr.)	>100%; nontoxic
			Aquatic Bioassay - Alga	
			● EC_{50}, 12-day	34.0%
			● EC_{50}, 17-day	56.5%
			● EC_{50}, 21-day	61.5%

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*Chemical results are a combination of ICP and spark source analyses.

TABLE 5-21. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR RUNOFF POND WATER FILTRATE

MEG Category	Estimated Concentration (µg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	9,100	1.0E-1	1.0E-1	a	e
50. Antimony	30	4.0E-3	1.5E-1	a	c	71. Manganese	374	1.5E0	3.7E0	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	44	8.8E-3	1.8E-2	c	c	69. Molybdenum	11	1.5E-4	1.6E-3	a	e
32. Beryllium	2	7E-2	4E-2	a	c	76. Nickel	12	5.2E-2	1.2E0	a	c
37. Boron	40	8.5E-4	1.6E-3	a	c	29. Potassium	2,700	9.0E-2	6.3E-2	a	a
82. Cadmium	4	8E-2	4E0	c	c	54. Selenium	NR				
34. Calcium	26,300	N	N	N	N	79. Silver	16	6.4E-2	3.2E0	c	c
68. Chromium	11	4.4E-2	4.4E-2	c	c	28. Sodium	9,800	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	117	2.5E-3	N	g	
78. Copper	8	2E-3	2E-1	c	c	45. Tin	<10	N	N	N	N
39. Gallium	<10	<1.4E-4	N	g	N	62. Titanium	17	1.9E-4	2.1E-2	a	e
72. Iron	550	N	N	N	N	65. Vanadium	8	3E-3	5E-2	a	e
46. Lead	70	2.8E-1	1.4E0	c	c	61. Yttrium	2	N	N	N	N
27. Lithium	3	9E-3	8E-3	a	c	81. Zinc	190	7.6E-3	1.9E0	c	c
SSMS DATA											
47. Ammonia	<100	<4E-2	<2E0	a	c	Palladium	<2	N	N	N	N
49. Arsenic	2	8E-3	4E-2	c	c	48. Phosphorus	200	N	N	N	N
51. Bismuth	<2	<3E-4	N	a	N	77. Platinum	<2	N	N	N	N
58. Bromine	50	N	N	N	N	84. Praseodymium	<2	N	N	N	N
84. Cerium	≤3	N	N	N	N	Rhenium	<2	N	N	N	N
31. Cesium	<2	N	N	N	N	75. Rhodium	<2	N	N	N	N
57. Chlorine	100	N	N	N	N	30. Rubidium	2	N	N	N	N
84. Dysprosium	<2	N	N	N	N	73. Ruthenium	<2	N	N	N	N
Erbium	<2	N	N	N	N	84. Samarium	<2	N	N	N	N
Europium	<2	N	N	N	N	60. Scandium	≤2	≤3E-6	N	g	N
56. Fluorine	≈800	N	N	N	N	54. Selenium	10	2E-1	4E-1	c	c
Gadolinium	<2	N	N	N	N	43. Silicon	800	N	N	N	N
44. Germanium	<2	<2E-4	N	a	N						
80. Gold	<2	N	N	N	N	53. Sulfur	5,000	7E-3	N	g	N
64. Hafnium	<2	N	N	N	N	67. Tantalum	<2	N	N	N	N
Holmium	<2	N	N	N	N	55. Tellurium	<2	1E-3	N	a	N
59. Iodine	30	N	N	N	N	Terbium	<2	N	N	N	N
Iridium	<2	N	N	N	N	41. Thallium	<2	<1E-3	N	a	N
84. Lanthanum	<2	N	N	N	N	85. Thorium	<20	<3E-4	<4E-2	h	N
Lutecium	<2	N	N	N	N	Thulium	<2	N	N	N	N
83. Mercury	<0.2	<2E-2	<8E-4	c	c	70. Tungsten	<2	<1E-4	N	a	N
84. Neodymium	<2	N	N	N	N	85. Uranium	<20	<3E-4	<4E-2	h	c
66. Niobium	<2	N	N	N	N	Ytterbium	<2	N	N	N	N
Osmium	<2	N	N	N	N	63. Zirconium	6	N	N	N	N
						Total Discharge Severity =		2.6E0	1.8E1		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-22. SUMMARY OF CHEMICAL TEST RESULTS FOR FINE REFUSE SLURRY FILTRATE AND BIOLOGICAL TEST RESULTS FOR FINE REFUSE SLURRY (RAW)

Discharge Severity Range (upper range exclusive)	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$			Ames	Negative
			CHO(EC_{50})	3.3 μl/ml; moderate effect
$10 - 10^2$			Rodent Acute (LD_{50})	>10g/kg; nontoxic
			Ecological	
$1 - 10$	Se	Se	Aquatic Bioassay - Fish (LC_{50}, 96 hr.) >100%; nontoxic	
			Aquatic Bioassay - Invertebrate (EC_{50}, 48 hr.) >100%; nontoxic	
			Aquatic Bioassay - Alga; moderate effect	
			● EC_{50}, 12-day	11.0%
			● EC_{50}, 17-day	13.5%
			● EC_{50}, 21-day	11.0%

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*Chemical results are a combination of ICP and spark source analyses.

TABLE 5-23. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR FINE WASTE SLURRY FILTRATE

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	3,320	3.7E-2	3.8E-2	a	e
50. Antimony	10	1.3E-3	5.0E-2	a	c	71. Manganese	34	1.4E-1	3.4E-1	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	157	3.1E-2	6.3E-2	c	c	69. Molybdenum	18	2.4E-4	2.6E-3	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	6	3E-2	6E-1	a	c
37. Boron	239	5.1E-3	9.6E-3	a	c	29. Potassium	4,500	1.5E-1	1.0E-1	a	a
82. Cadmium	<2	<4E-2	<2E0	c	c	54. Selenium	NR				
34. Calcium	7,700	N	N	N	N	79. Silver	<1	<4E-3	<2E-1	c	c
68. Chromium	18	7.2E-2	7.2E-2	c	c	28. Sodium	98,400	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	156	3.4E-3	N	g	N
78. Copper	<1	<2E-4	<2E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	<10	<1.4E-4	N	g	N	62. Titanium	189	2.1E-3	2.3E-1	a	e
72. Iron	1,770	N	N	N	N	65. Vanadium	12	4.8E-3	8.0E-2	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	15	4.5E-2	4.0E-2	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	<100	<4E-2	<2E0	c	e	Palladium	<7	N	N	N	N
49. Arsenic	20	8E-2	4E-1	c	c	48. Phosphorus	600	N	N	N	N
51. Bismuth	<7	<1E-3	N	a	N	77. Platinum	<7	N	N	N	N
58. Bromine	300	N	N	N	N	84. Praseodymium	<7	N	N	N	N
84. Cerium	40	N	N	N	N	Rhenium	<7	N	N	N	N
31. Cesium	<7	N	N	N	N	75. Rhodium	<7	N	N	N	N
57. Chlorine	1,000	N	N	N	N	30. Rubidium	70	N	N	N	N
84. Dysprosium	<7	N	N	N	N	73. Ruthenium	<7	N	N	N	N
Erbium	<7	N	N	N	N	84. Samarium	<7	N	N	N	N
Europium	<7	N	N	N	N	60. Scandium	≤9	≤1E-5	N	g	N
56. Fluorine	≈800	N	N	N	N	54. Selenium	50	1E0	2E0	c	c
Gadolinium	<7	N	N	N	N	43. Silicon	>10,000	N	N	N	N
44. Germanium	<7	<8E-4	N	a	N						
80. Gold	<7	N	N	N	N	53. Sulfur	>10,000	N	N	N	N
64. Hafnium	<7	N	N	N	N	67. Tantalum	≤20	N	N	N	N
Holmium	<7	N	N	N	N	55. Tellurium	<7	<5E-3	N	a	N
59. Iodine	200	N	N	N	N	Terbium	<7	N	N	N	N
Iridium	<7	N	N	N	N	41. Thallium	<7	<5E-3	N	a	N
84. Lanthanum	20	N	N	N	N	85. Thorium	<60	<1E-3	<1E-1	h	N
Lutecium	<7	N	N	N	N	Thulium	<7	N	N	N	N
83. Mercury	<0.2	<2E-2	<8E-4	c	c	70. Tungsten	<7	<5E-4	N	a	N
84. Neodymium	<7	N	N	N	N	85. Uranium	<50	<8E-4	<1E-1	a	e
66. Niobium	30	N	N	N	N	Ytterbium	<7	N	N	N	N
Osmium	<7	N	N	N	N	63. Zirconium	50	N	N	N	N

Total Discharge Severity = 2.0E0 1.0E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

Table 5-22 also shows the results of the health-related and ecologically related biological tests on an unfiltered sample. The Ames assay produced negative results and the rodent acute test showed low or nondetectable effects (LD_{50} >g/kg). The CHO clonal assay, however, showed moderate cellular metabolic impairment (EC_{50} was 3.3 µl/ml). The fine refuse slurry showed low or nondetectable effects on fish and invertebrates and moderate effects on algae (i.e., EC_{50} was 11.0 percent, 13.5 percent, and 11.0 percent for 12-, 17-, and 21-day exposures, respectively).

The majority of the liquid waste streams show lead ammonia and cadmium to have discharge severity values greater than one. However, lead ammonia and cadmium are not shown on the summary tables because of a degree of uncertainty. It appears that the ecological DMEG values for lead ammonia and cadmium are equal to or less than the detection limits for lead ammonia and cadmium.

The TCO and Grav results, based on a filtered samples were 300 µg/ℓ. As with the pond waters, the only measurable value was from the gravimetric analysis.

5.2.4 Solid and Leachate Waste Streams

Ten solid waste streams were sampled at coal preparation plant No. 2: ROM coal, fine refuse, coarse refuse, clean coal, desilting pond sediment, transfer pond sediment, runoff pond sediment, and filtered solids from the desilting pond water, transfer pond water, and runoff pond water. Except for the fine refuse and filtered solids, a leachate was generated from each solid sample. The solid samples and their leachates were analyzed for trace elements and biological effects. In addition, the pond sediments and leachates were analyzed for total extractable organics. The results of these analyzers are presented in Section 5.2.4. Classical water quality parameter results are presented in Section 5.2.5, Water Quality Tests.

5.2.4.1 Fine Refuse Slurry (Dewatered)--

The SAM/1A evaluation results for the inorganic tests are provided in Tables 5-24 and 5-25. As indicated in this table, the health-based TDS is 492, while the ecological-based TDS is approximately 10,300. The major

TABLE 5-24. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR FINE REFUSE (DEWATERED)

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results
	Health	Ecological	
$10^3 - 10^4$		P	
$10^2 - 10^3$	Cr, Mn		
$10 - 10^2$	Ba, Pb, Ni, P, Se, V		Health Not conducted.
$1 - 10$	As, Be, Cd, Cu, Li, Mg, Hg, Sr, Ti, Zn	Ba, Cd, Cr, Cu, Pb Mn, Ni, Ti, V, Zn	Ecological Not conducted.

TABLE 5-25. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR FINE REFUSE (Dewatered)

MEG Category	Estimated Concentration (µg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>130	>8.1E-1	>6.5E-1	a	c	39. Gallium	19	1.3E-1	N	d	N
47. Ammonia	NR			c	e	44. Germanium	0.7	4E-2	N	a	N
50. Antimony	1	7E-2	3E-2	a	c	80. Gold	<0.1	N	N	N	N
49. Arsenic	3	6E0	3E-1	c	c	64. Hafnium	<0.1	N	N	N	N
36. Barium	620	6.2E1	1.2E0	c	c	Holmium	0.7	N	N	N	N
32. Beryllium	0.2	3E0	2E-2	a	c	59. Iodine	0.6	N	N	N	N
51. Bismuth	<0.1	<8E-3	N	g	N	Iridium	<0.1	N	N	N	N
37. Boron	12	1.3E-1	2.4E-3	a	c	72. Iron	>1,000	N	N	N	N
58. Bromine	1	N	N	N	N	84. Lanthanum	34	N	N	N	N
82. Cadmium	0.4	4E0	2E0	d	c	46. Lead	23	4.6E1	2.3E0	c	c
34. Calcium	>1,000	N	N	N	N	27. Lithium	5	7E0	7E-2	a	c
84. Cerium	34	N	N	N	N	Lutecium	<0.1	N	N	N	N
31. Cesium	9	N	N	N	N	33. Magnesium	>1,000	>5.6E0	>5.7E-2	a	e
57. Chlorine	33	N	N	N	N	71. Manganese	66	1.3E2	3.3E0	c	c
68. Chromium	66	1.3E2	1.3E0	c	c	83. Mercury	0.03	2E0	6E-4	c	c
74. Cobalt	1	7E-1	2E-2	a	c	69. Molybdenum	6	4E-2	4E-3	a	e
78. Copper	23	2.3E0	2.3E0	a	a	84. Neodymium	12	N	N	N	N
84. Dysprosium	3	N	N	N	N	76. Nickel	5	1E1	3E0	a	c
Erbium	0.5	N	N	N	N	66. Niobium	7	N	N	N	N
Europium	0.6	N	N	N	N	Osmium	<0.1	N	N	N	N
56. Fluorine	∿200	N	N	N	N	Palladium	<0.1	N	n	N	N
Gadolinium	2	N	N	N	N	48. Phosphorus	>1,000	>3.3E1	>1E4	a	c

TABLE 5-25. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR FINE REFUSE (Dewatered)

(Continued)

MEG Category	Estimated Concentration (μg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.1	N	N	N	N	67. Tantalum	<0.1	N	N	N	N
29. Potassium	>1,000	N	N	N	N	55. Tellurium	≤0.8	≤3E-1	N	a	N
84. Praseodymium	7	N	N	N	N	Terbium	0.6	N	N	N	N
Rhenium	<0.1	N	N	N	N	41. Thallium	<0.1	<3E-2	N	a	N
75. Rhodium	<0.1	N	N	N	N	85. Thorium	25	2.1E-1	2.5E-1	h	c
30. Rubidium	110	N	N	N	N	Thulium	<0.1	N	N	N	N
73. Ruthenium	<0.1	N	N	N	N	45. Tin	1	N	N	N	N
84. Samarium	7	N	N	N	N	62. Titanium	>1,000	>5.6E0	>6.3E0	a	e
60. Scandium	8	5E-3	N	g	N	70. Tungsten	<0.1	<3E-3	N	a	N
54. Selenium	2	2E1	4E-1	c	c	85. Uranium	11	9.2E-2	1.1E-1	h	c
43. Silicon	>1,000	N	N	N	N	65. Vanadium	98	2.0E1	3.3E0	a	e
79. Silver	<0.1	<2E-1	<1E-2	c	c	Ytterbium	<0.1	N	N	N	N
28. Sodium	>330	N	N	N	N	61. Yttrium	19	N	N	N	N
35. Strontium	93	1E0	N	g	N	81. Zinc	86	1.7E0	4.3E0	c	c
53. Elemental Sulfur	>810	N	N	N	N	63. Zirconium	110	N	N	N	N

Total Discharge Severity 4.9E2 1.0E4

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

contributor to the high ecological-based TDS is phosphorus which has an individual DS of 10,000. For the health-based TDS, the major contributors are manganese and chromium with individual DS values of 130 for each.

The biological effects tests were performed on the fine refuse slurry, rather than the filtered solids (see Section 5.2.3.5).

5.2.4.2 Coarse Refuse and Coarse Refuse Leachate—

The TDS values for the coarse refuse, as determined by the SAM/1A evaluation are 2,069 (health based) and 10,088 (ecological-based). As with the dewatered fine refuse slurry, phosphorus with a DS value of approximately 10,000 is the major contributor to the high ecological-based TDS. For the health-based TDS, the major contributors are manganese, lead, and selenium with individual DS values of 1,000, 540, and 180, respectively. The individual DS values for the major contributors and other compounds are shown in Table 5-27.

Table 5-26 also presents the results of the biological effects tests. The results for the health related biological tests are negative for the Ames assay and nontoxic for the RAM (EC_{50} is >1,000 μg/ml). Ecological-related biological tests were not performed.

For the coarse refuse leachate, the health-based TDS is 10 and the ecological-based TDS is approximately 200. The significant contributors to the ecological-based value are ammonia, manganese, and nickel. The SAM/1A evaluation for inorganics is summarized in Table 5-28. The specific DS values for each constituent are presented in Table 5-29.

The health-related biological assessment for coarse refuse leachate showed a negative response for the Ames assay and low or nondetectable response for the CHO clonal assay (EC_{50} >600 μl/ml). This leachate was combined with clean coal and ROM leachate for ecological-related aquatic bioassays. There were little or no nondetectable effects for fish and invertebrates, but the EC_{50} values for algae of 25.0 percent, 32.0 percent, and 33.0 percent for 12-, 17-, and 21-day exposures, respectively, reflect a moderate effect.

TABLE 5-26. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR COARSE REFUSE

Discharge Severity Range (upper limit exclusive)	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
10^3 - 10^4	Mn	P		
			Health	
10^2 - 10^3	Pb, Se		Ames	Negative
			RAM (EC_{50})	>1,000 µg/ml; nontoxic (% phagocykosis)
10 - 10^2	As, Ba, Cd, Cr, Li Ni, P, V	Pb, Mn		>1,000 µg/ml; nontoxic (nmol ATP/well)
			Ecological	
1 - 10	Be, Co, Cu, Mg, Hg Sr, Tl, Ti	As, Ba, Cd, Cu, Se Ni, Ti, V, Zn	Not conducted	

TABLE 5-27. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR COARSE REFUSE

MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>150	>9.4E-1	>7.5E-1	a	c	39. Gallium	12	8.0E-2	N	d	N
47. Ammonia	NR			c	e	44. Germanium	3	2E-1	N	a	N
50. Antimony	3	2E-1	8E-2	a	c	80. Gold	<0.1	N	N	N	N
49. Arsenic	31	6.3E1	3.1E0	c	c	64. Hafnium	2	N	N	N	N
36. Barium	720	7.3E1	1.4E0	c	c	Holmium	0.8	N	N	N	N
32. Beryllium	0.3	5E0	3E-2	a	c	59. Iodine	0.7	N	N	N	N
51. Bismuth	<0.1	<8E-3	N	g		Iridium	<0.1	N	N	N	N
37. Boron	35	3.8E-1	7.0E-3	a	c	72. Iron	>1,000	N	N	N	N
58. Bromine	3	N	N	N	N	84. Lanthanum	62	N	N	N	N
82. Cadmium	1	1E1	5E0	d	c	46. Lead	270	5.4E2	2.7E1	c	c
34. Calcium	>1,000	N	N	N	N	27. Lithium	9	1.3E1	1E-1	a	c
84. Cerium	88	N	N	N	N	Lutecium	<0.1	N	N	N	N
31. Cesium	18	N	N	N	N	33. Magnesium	>1,000	>5.5E0	>5.7E-1	a	e
57. Chlorine	21	N	N	N	N	71. Manganese	510	1.0E3	2.6E1	c	c
68. Chromium	43	8.6E1	8.6E-1	c	c	83. Mercury	0.18	9.0E0	3.6E-3	c	c
74. Cobalt	5	3E0	1E-1	a	c	69. Molybdenum	17	1.1E-1	1.2E-2	a	e
78. Copper	51	5.1E0	5.1E0	a	a	84. Neodymium	13	N	N	N	N
84. Dysprosium	1	N	N	N	N	76. Nickel	6	1.3E1	3E0	a	c
Erbium	0.6	N	N	N	N	66. Niobium	10	N	N	N	N
Europium	0.4	N	N	N	N	Osmium	<0.1	N	N	N	N
56. Fluorine	≃230	N	N	N	N	Palladium	<0.1	N	N	N	N
Gadolinium	2	N	N	N	N	48. Phosphorus	>1,000	>3.3E1	>1E4	a	c

TABLE 5-27. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR COARSE REFUSE

(Continued)

MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.1	N	N	N	N	67. Tantalum	<0.1	N	N		
29. Potassium	>1,000	N	N	N	N	55. Tellurium	0.3	1E-1	N	a	N
84. Praseodymium	17	N	N	N	N	Terbium	0.5	N	N	N	N
Rhenium	<0.1	N	N	N	N	41. Thallium	4	1E0	N	a	N
75. Rhodium	<0.1	N	N	N	N	85. Thorium	14	1.2E-1	1.4E-1	h	c
30. Rubidium	130	N	N	N	N	Thulium	≤0.1	N	N	N	N
73. Ruthenium	<0.1	N	N	N	N	45. Tin	1	N	N	N	N
84. Samarium	8	N	N	N	N	62. Titanium	>1,000	>5.6E0	>6.3E0	a	e
60. Scandium	2	1E-3	N	g	N	70. Tungsten	<0.1	<3E-3	N	a	
54. Selenium	18	1.8E2	3.6E0	c	c	85. Uranium	13	1.1E-1	1.3E-1	h	c
43. Silicon	>1,000	N	N	N	N	65. Vanadium	110	2.2E1	3.7E0	a	e
79. Silver	<0.1	<2E-1	<1E-2	c	c	Ytterbium	<0.1	N	N	N	N
28. Sodium	>380	N	N	N	N	61. Yttrium	22	N	N	N	N
35. Strontium	110	1.2E0	N	g	N	81. Zinc	25	5.0E-1	1.3E0	c	c
53. Elemental Sulfur	>930	N	N	N	N	63. Zirconium	97	N	N	N	N
						Total Discharge Severity		2.1E3	1.0E4		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-28. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR COARSE REFUSE LEACHATE

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$		NH_3-N	Ames	Negative
			CHO(EC_{50})	>600 µl/ml; nontoxic
$10 - 10^2$		Mn, Ni		
			Ecological	
$1 - 10$	Mn, NH_3-N	(Ag)	**Aquatic Bioassay-- Fish (LC_{50}, 48 hr.) >100%; nontoxic **Aquatic Bioassay-- Invertebrates (EC_{50}, 48 hr) >100%; nontoxic **Aquatic Bioassay-- Algae; moderate effect o EC_{50}, 12-day, 25.0% o EC_{50}, 17-day, 32.0% o EC_{50}, 21-day, 33.0%	

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*The chemical results are a combination of ICP and spark source analysis.

**Composite of clean coal, ROM coal, and coarse refuse leachates.

( )Analytical results indicate possible contamination.

TABLE 5-29. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR COARSE REFUSE LEACHATE

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc) Health	Discharge Severity (Estimated Conc/ DMEG Conc) Ecological	Basis for Mate Value Health	Basis for Mate Value Ecological	MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc) Health	Discharge Severity (Estimated Conc/ DMEG Conc) Ecological	Basis for Mate Value Health	Basis for Mate Value Ecological
ICP DATA											
38. Aluminum	<30	<3.8 E-4	<3.0 E-2	a	c	33. Magnesium	36,290	4.0 E-1	4.2 E-1	a	e
50. Antimony	<19	<2.5 E-3	<9.5 E-2	a	c	71. Manganese	1,078	4.3E0	1.1 E1	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	50	1.0 E-2	2.0 E-2	c	c	69. Molybdenum	<2	<3 E-5	<3 E-4	a	e
32. Beryllium	<1	<3 E-2	<2 E-2	a	c	76. Nickel	192	8.3 E-1	1.9E1	a	c
37. Boron	460	9.8 E-3	1.8 E-2	a	c	29. Potassium	19,200	6.4 E-1	4.5 E-1	a	a
82. Cadmium	<2	<4 E-2	<2 E 0	c	c	54. Selenium	NR				
34. Calcium	>49,900	N	N	N	N	79. Silver	<30	<1.2 E-1	<6 E0	c	c
68. Chromium	<13	<5.2 E-2	<5.2 E-2	c	c	28. Sodium	205,450	N	N	N	N
74. Cobalt	<9	<1 E-2	<4 E-2	c	c	35. Strontium	3,000	6.5 E-2	N	g	N
78. Copper	<3	<6 E-4	<6 E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	Interference			g		62. Titanium	<6	<7 E-5	<7 E-3	a	e
72. Iron	<14	N	N	N	N	65. Vanadium	22	8.8 E-3	1.5 E-1	a	e
46. Lead	<50	<2.0 E-1	<1.0 E 0	c	c	61. Yttrium	<2	N	N	N	N
27. Lithium	65	2.0 E-1	1.7 E-1	a	c	81. Zinc	<50	<2.0 E-3	<5.0 E-1	c	c
SSMS DATA											
47. Ammonia	8,100	3.2 E 0	1.6E2	c	e	Palladium	<1	N	N	N	N
49. Arsenic	<2	<8 E-3	<4 E-2	c	c	48. Phosphorus	<800	N	N	N	N
51. Bismuth	<1	<2 E-4	N	a	N	77. Platinum	<1	N	N	N	N
58. Bromine	30	N	N	N	N	84. Praseodymium	<1	N	N	N	N
84. Cerium	<1	N	N	N	N	Rhenium	<1	N	N	N	N
31. Cesium	<1	N	N	N	N	75. Rhodium	<1	N	N	N	N
57. Chlorine	<100	N	N	N	N	30. Rubidium	<20	N	N	N	N
84. Dysprosium	<1	N	N	N	N	73. Ruthenium	<1	N	N	N	N
Erbium	<1	N	N	N	N	84. Samarium	<1	N	N	N	N
Europium	<1	N	N	N	N	60. Scandium	<1	<1 E-6	N	g	N
56. Fluorine	≈299	N	N	N	N	54. Selenium	<6	<1 E-1	<2 E-1	c	c
Gadolinium	1	N	N	N	N	43. Silicon	<800	N	N	N	N
44. Germanium	<4	<5 E-3	N	a	N						
80. Gold	<1	N	N	N	N	59. Sulfur	>5,920	N	N	N	N
64. Hafnium	<1	N	N	N	N	67. Tantalum	<1	N	N	N	N
Holmium	<1	N	N	N	N	55. Tellurium	<2	<1 E-3	N	a	N
59. Iodine	20	N	N	N	N	Terbium	<1	N	N	N	N
Iridium	<1	N	N	N	N	41. Thallium	<1	<7 E-4	N	a	N
84. Lanthanum	<1	N	N	N	N	85. Thorium	<10	<2 E-4	<2 E-2	h	N
Lutecium	<1	N	N	N	N	Thulium	<1	N	N	N	N
83. Mercury	<0.5	<5 E-2	<2 E-3	c	c	70. Tungsten	<1	<7 E-5	N	a	N
84. Neodymium	<1	N	N	N	N	85. Uranium	<8	<1 E-4	<2 E-2	h	c
66. Niobium	<1	N	N	N	N	Ytterbium	<1	N	N	N	N
Osmium	<1	N	N	N	N	63. Zirconium	<3	N	N	N	N
						Total Discharge Severity =		8.7E0	2.0E2		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

The TCO and Grav analysis showed that both had concentrations at less than the detection limit of 1.0 mg/ℓ; therefore, no detectable extractable organic material was found.

5.2.4.3 ROM Coal and ROM Coal Leachate--

Feed coal was sampled and analyzed for inorganic chemical content (Appendix A), proximate and ultimate analyses (Section 5.2.5), and a leachable material. The SAM/1A evaluation of the inorganic chemicals in the leachate had a health-based TDS of 4 and an ecological-based TDS of approximately 100. For the health-based TDS, only manganese had a DS value greater than one, whereas the ecological-based TDS had six constituents with DS values greater than or equal to one. The TDS and biological assessment results are summarized in Table 5-30. The individual DS values for ROM coal leachate are given in Table 5-31.

The ROM coal and leachate were tested for health effects, and low or nondetectable effects were produced using the Ames assay (both samples), RAM assay (ROM coal), and CHO clonal assay (leachate) tests. A composite of ROM coal, clean coal, and coarse refuse was used for ecological-related biological effects; therefore, the results are the same as presented in Section 5.2.4.2.

The extractable organics concentrations were below the detection limit of 1.0 mg/ℓ for both chromatographable and gravimetric analysis.

5.2.4.4 Clean Coal and Clean Coal Leachate--

As with the ROM coal, inorganic chemical analyses (Appendix A), proximate and ultimate analyses (Section 5.2.5), and leachable chemical analyses were performed on the clean coal. The health-based TDS for inorganic leachable constituents was about 2 and the ecological-based TDS was approximately 1,630. As with the coarse refuse and ROM coal leachates, the major contributor to the ecological-based TDS was ammonia. A summary of the major TDS values and biological assessment results of clean coal and leachate is provided in Table 5-32. The specific DS values for each element are listed in Table 5-33.

TABLE 5-30. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR ROM COAL AND ROM COAL LEACHATE

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$			(Leachate) Ames	Negative
			CHO(EC_{50})	>600 µl/ml; nontoxic
$10 - 10^2$		NH_3-N	(Coal) Ames	Negative
			RAM(EC_{50})	>1,000 µg/ml; nontoxic (% phagocytosis) >1,000 µg/ml; nontoxic (nmol ATP/well)
			Ecological	
$1 - 10$	Mn	Mn, Ni, (Ag)		

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*The chemical results are a combination of ICP and spark source analyses.

**Composite of clean coal, ROM coal, and coarse refuse leachates.

( )Analytical results indicate possible contamination.

TABLE 5-31. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR ROM COAL LEACHATE

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3 E-4	<1.0 E-2	a	c	33. Magnesium	13,891	1.5 E-1	1.6 E-1	a	e
50. Antimony	<10	<1.3 E-3	<5.0 E-2	a	c	71. Manganese	422	1.7 E0	4.2 E0	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	51	1.0 E-2	2.0 E-2	c	c	69. Molybdenum	<16	<2.1 E-4	<2.3 E-3	a	e
32. Beryllium	<1	<3 E-2	<2 E-2	a	c	76. Nickel	<41	<1.8 E-1	<4.1 E0	a	c
37. Boron	300	6.4 E-3	1.2 E-2	a	c	29. Potassium	9,900	3.3 E-1	2.3 E-1	a	a
82. Cadmium	<2	<4 E-2	<2 E 0	c	c	54. Selenium	NR				
34. Calcium	105,000	N	N	N	N	79. Silver	<30	<1.2 E-1	<6 E0	c	c
68. Chromium	<2	<8 E-3	<8 E-3	c	c	28. Sodium	117,454	N	N	N	N
74. Cobalt	<12	<1.6 E-2	<4.8 E-2	c	c	35. Strontium	951	2.1 E-2	N	g	N
78. Copper	<1	<2 E-4	<2 E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	Interference			g		62. Titanium	<1	<1 E-5	<1 E-3	a	e
72. Iron	<10	N	N	N	N	65. Vanadium	<5	<2 E-3	<3 E-2	a	e
46. Lead	<50	<2 E-1	<1 E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	26	7.9 E-2	6.9 E-2	a	c	81. Zinc	<50	<2.0 E-3	<5.0 E-1	c	c
SSMS DATA											
47. Ammonia	2,400	9.6 E-1	4.8 E1	c	e	Palladium	<1	N	N	N	N
49. Arsenic	<2	<8 E-3	<4 E-2	c	c	48. Phosphorus	<800	N	N	N	N
51. Bismuth	<1	<2 E-4		a	N	77. Platinum	<1	N	N	N	N
58. Bromine	20	N	N	N	N	84. Praseodymium	<1	N	N	N	N
84. Cerium	<1	N	N	N	N	Rhenium	<1	N	N	N	N
31. Cesium	<1	N	N	N	N	75. Rhodium	<1	N	N	N	N
57. Chlorine	<100	N	N	N	N	30. Rubidium	<10	N	N	N	N
84. Dysprosium	<1	N	N	N	N	73. Ruthenium	<1	N	N	N	N
Erbium	<1	N	N	N	N	84. Samarium	<1	N	N	N	N
Europium	<1	N	N	N	N	60. Scandium	<1	<1 E-6	N	g	N
56. Fluorine	≈49	N	N	N	N	54. Selenium	<2	<4 E-2	<8 E-2	c	c
Gadolinium	<1	N	N	N	N	43. Silicon	<800	N	N	N	N
44. Germanium	<1	<1 E-4	N	a	N						
80. Gold	<1	N	N	N	N	53. Sulfur	<1,920	N	N	N	N
64. Hafnium	<1	N	N	N	N	67. Tantalum	<1	N	N	N	N
Holmium	<1	N	N	N	N	55. Tellurium	<1	<7 E-4	N	a	N
59. Iodine	1	N	N	N	N	Terbium	<1	N	N	N	N
Iridium	<1	N	N	N	N	41. Thallium	<1	<7 E-4	N	a	N
84. Lanthanum	<1	N	N	N	N	85. Thorium	<10	<1.7 E-4	<2.0 E-2	h	N
Lutecium	<1	N	N	N	N	Thulium	<1	N	N	N	N
83. Mercury	<0.5	<5 E-2	<2 E-3	c	c	70. Tungsten	<1	<7 E-5	N	a	N
84. Neodymium	<1	N	N	N	N	85. Uranium	<9	<2 E-4	<2 E-2	h	c
66. Niobium	<1	N	N	N	N	Ytterbium	<1	N	N	N	N
Osmium	<1	N	N	N	N	63. Zirconium	<2	N	N	N	N

Total Discharge Severity = 4.0E0 6.7E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5- 32 SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR CLEAN COAL AND CLEAN COAL LEACHATE

Discharge Severity Range	Compounds Found From Chemical Analysis* Health	 Ecological		Bioassay Test Results	
$10^3 - 10^4$	No health-related discharge severity values greater than 1.				
				Health	
$10^2 - 10^3$			(Leachate)	Ames	Negative
				CHO(EC_{50})	>600 µl/ml; nontoxic
$10 - 10^2$		NH_3-N	(Coal)	Ames	Negative
				RAM (EC_{50})	>1,000 µg/ml; nontoxic (% phagocytosis) >1,000 µg/ml; nontoxic (nmol ATP/well)
				Ecological	
1 - 10		Mn, Ni, (Ag)		** Aquatic Bioassay - Fish (LC_{50}, 96-hr.) >100%; nontoxic	
				** Aquatic Bioassay - Invertebrate (EC_{50}, 48-hr.) >100%; nontoxic	
				** Aquatic Bioassay - Alga; moderate effect	
				● EC_{50}, 12-day	25.0%
				● EC_{50}, 17-day	32.0%
				● EC_{50}, 21-day	33.0%

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* The chemical results are a combination of ICP and spark source analyses.

** Composite of clean coal, ROM coal, and coarse refuse leachates.

( ) Analytical results indicate possible contamination.

TABLE 5-33. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR CLEAN COAL LEACHATE

ICP DATA

MEG Category	Estimated Concentration (µg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	<10	<1.3 E-4	<1.0 E-2	a	c	33. Magnesium	6,461	7.2 E-2	7.4 E-2	a	e
50. Antimony	<10	<1.3 E-3	<5.0 E-2	a	c	71. Manganese	236	9.4 E-1	2.4 E 0	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	90	1.8 E-2	3.6 E-2	c	c	69. Molybdenum	<14	<1.9 E-4	<2.0 E-3	a	e
32. Beryllium	<1	<3 E-2	<2 E-2	a	c	76. Nickel	<29	<1.3 E-1	<2.9 E 0	a	c
37. Boron	143	3.0 E-3	5.7 E-3	a	c	29. Potassium	2,200	7.3 E-2	5.1 E-2	a	a
82. Cadmium	<2	<4 E-2	<2 E 0	c	c	54. Selenium	NR				
34. Calcium	76,400	N	N	N	N	79. Silver	<30	<1.2 E-1	<6 E 0		
68. Chromium	<2	<8 E-3	<8 E-3	c	c	28. Sodium	19,954	N	N	N	N
74. Cobalt	<13	<1.7 E-2	<5.2 E-2	c	c	35. Strontium	427	9.3 E-3	N	g	N
78. Copper	<1	<2 E-4	<2 E-2	c	c	45. Tin	<15	N	N	N	N
39. Gallium	Interference		N	g	N	62. Titanium	<1	<1 E-5	<1 E-3	a	e
72. Iron	<10	N	N	N	N	65. Vanadium	<1	<4 E-4	<7 E-3	a	e
46. Lead	<50	<2.0 E-1	<1.0 E 0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	<8	<2 E-2	<2 E-2	a	c	81. Zinc	<50	<2.0 E-3	<5.0 E-1	c	c
SSMS DATA											
47. Ammonia	750	3 E-1	2 E 1	c	e	Palladium	<1	N	N	N	N
49. Arsenic	<2	<8 E-3	<4 E 2	c	c	48. Phosphorus	<800	N	N	N	N
51. Bismuth	<1	<2 E-3	N	a	N	77. Platinum	<1	N	N	N	N
58. Bromine	30	N	N	N	N	84. Praseodymium	<1	N	N	N	N
84. Cerium	<1	N	N	N	N	Rhenium	<1	N	N	N	N
31. Cesium	<3	N	N	N	N	75. Rhodium	<1	N	N	N	N
57. Chlorine	100	N	N	N	N	30. Rubidium	<4	N	N	N	N
84. Dysprosium	<1	N	N	N	N	73. Ruthenium	<1	N	N	N	N
Erbium	<1	N	N	N	N	84. Samarium	<1	N	N	N	N
Europium	<1	N	N	N	N	60. Scandium	<1	1 E-6	N	g	N
56. Fluorine	<1	N	N	N	N	54. Selenium	<5	<1 E-1	<2 E-1	c	c
Gadolinium	<1	N	N	N	N	43. Silicon	<800	N	N	N	N
44. Germanium	<1	<1 E-4	N	a	N						
80. Gold	<1	N	N	N	N	53. Sulfur	>9,900	N	N	N	N
64. Hafnium	<1	N	N	N	N	67. Tantalum	<1	N	N	N	N
Holmium	<1	N	N	N	N	55. Tellurium	<2	<1 E-3	N	a	N
59. Iodine	<2	N	N	N	N	Terbium	<1	N	N	N	N
Iridium	<1	N	N	N	N	41. Thallium	<1	<7 E-4	N	a	N
84. Lanthanum	<1	N	N	N	N	85. Thorium	<10	<1.7 E-4	<2.0 E-2	h	N
Lutecium	<1	N	N	N	N	Thulium	<1	N	N	N	N
83. Mercury	<0.5	<5 E-2	<2 E-3	c	c	70. Tungsten	<1	7 E-5	N	a	N
84. Neodymium	< 1	N	N	N	N	85. Uranium	<20	<3.3 E-4	<4.0 E-2	h	c
66. Niobium	< 1	N	N	N	N	Ytterbium	<1	N	N	N	N
Osmium	< 1	N	N	N	N	63. Zirconium	<2	N	N	N	N

Total Discharge Severity = 2.2E0 3.5E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

The clean coal and leachate were tested for health effects, and low or nondetectable effects were produced using the Ames assay (both samples), RAM assay (clean coal), and CHO clonal assay (leachate) tests. The ecological-related bioassay results for the leachate are presented in the coarse refuse leachate discussion (Section 5.2.4.2).

The TCO and Grav analyses for extractable organics again showed no detectable concentrations.

5.2.4.5 Desilting Pond Sediment and Desilting Pond Sediment Leachate--

The TDS values for the desilting pond sediment, as determined by the SAM/1A evaluation, are 1,628 (health based) and 3,091 (ecological based). The results are summarized in Table 5-34. As with other solids, phosphorus with a DS value of approximately 3,000 is the major contributor to the high ecological-based TDS. The major contributors to the health-based TDS are manganese and barium with individual DS values of 1,300 and 100, respectively. Individual discharge severity values for the major contributors and all other compounds are shown in Table 5-35.

Table 5-34 also presents the results of the biological effects tests. The results for the health-related biological tests are negative for the Ames assay, but the RAM assay shows a high cellular toxic effect (EC_{50} is 1.0 μg/ml). The RAM assay was performed on a composite of desilting pond sediment and transfer pond sediment. Ecological-related biological tests were not performed.

The health-based TDS for desilting pond sediment leachate is 4 and the ecological-based TDS is approximately 20. The ecological-based TDS shows silver, cadmium, manganese, lead, and ammonia with DS values greater than or equal to one. The health-based TDS showed only manganese with a DS value greater than one. A summary of the significant DS values and biological assessment results of the desilting pond sediment leachate are presented in Table 5-36. The specific DS values for each element are listed in Table 5-37.

TABLE 5-34. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR DESILTING POND SEDIMENT

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	Mn	P		
$10^2 - 10^3$	Ba		**Health** Ames	Negative
$10 - 10^2$	As, Cr, Pb, Li, Ni P, V	Mn, V	RAM(EC_{50})*	1.0 µg/ml;high effect (% phagocytosis) 0.32 µl/ml (nmol ATP/well)
$1 - 10$	Al, Be, Cd, Cu, Mg Se, Sr, Ti	As, Ba, Cd, Cu, Pb Ni, Ti, Zn	**Ecological** Not conducted.	

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* Composite of desilting pond sediment and transfer pond sediment.

TABLE 5-35. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DESILTING POND SEDIMENT

MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>190	>1.2E0	>9.5E-1	a	c	39. Gallium	16	1.1E-1	N	d	N
47. Ammonia	NR			c	e	44. Germanium	0.4	2E-2	N	a	N
50. Antimony	<0.1	<7E-3	<3E-3	a	c	80. Gold	<0.1	N	N	N	N
49. Arsenic	10	2.0E1	1.0E0	c	c	64. Hafnium	5	N	N	N	N
36. Barium	>1,000	>1.0E2	>2.0E0	c	c	Holmium	2	N	N	N	N
32. Beryllium	<0.1	<2E0	<9E-3	a	c	59. Iodine	4	N	N	N	N
51. Bismuth	<0.1	<8E-3		g	-	Iridium	<0.1	N	N	N	N
37. Boron	8	9E-2	2E-3	a	c	72. Iron	<1,000	N	N	N	N
58. Bromine	2	N	N	N	N	84. Lanthanum	44	N	N	N	N
82. Cadmium	≤0.3	≤3E0	≤2E0	N	N	46. Lead	15	3E1	2E0	c	c
34. Calcium	>1,000	N	N	N	N	27. Lithium	7	1E1	9E-2	a	c
84. Cerium	28	N	N	N	N	Lutecium	0.8	N	N	N	N
31. Cesium	3	N	N	N	N	33. Magnesium	>1,000	>5.6E0	>5.7E-2	a	e
57. Chlorine	9	N	N	N	N	71. Manganese	640	1.3E3	3.2E1	N	N
68. Chromium	46	9.2E1	9.2E-1	c	c	83. Mercury	0.01	5E-1	2E-4	c	c
74. Cobalt	0.6	4E-1	1E-2	a	c	69. Molybdenum	2	1E-2	1E-3	a	e
78. Copper	11	1.1E0	1.1E0	a	a	84. Neodymium	17	N	N	N	N
84. Dysprosium	4	N	N	N	N	76. Nickel	8	2E1	4E0	a	c
Erbium	2	N	N	N	N	66. Niobium	24	N	N	N	N
Europium	1	N	N	N	N	Osmium	<0.1	N	N	N	N
56. Fluorine	≃67	N	N	N	N	Palladium	<0.1	N	N	N	N
Gadolinium	5	N	N	N	N	48. Phosphorus	330	1.1E1	3E3	a	c

TABLE 5-35. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DESILTING POND SEDIMENT

(Continued)

MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc) Health	Ecological	Basis for Mate Value Health	Ecological	MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc) Health	Ecological	Basis for Mate Value Health	Ecological
77. Platinum	<0.1	N	N	N	N	67. Tantalum	<0.1	N	N	N	N
29. Potassium	>1,000	N	N	N	N	55. Tellurium	<0.1	<3E-2	N	a	N
84. Praseodymium	8	N	N	N	N	Terbium	0.8	N	N	N	N
Rhenium	<0.1	N	N	N	N	41. Thallium	<0.1	<3E-2	N	a	N
75. Rhodium	<0.1	N	N	N	N	85. Thorium	32	2.7E-1	3.2E-1	h	c
30. Rubidium	73	N	N	N	N	Thulium	0.6	N	N	N	N
73. Ruthenium	<0.1	N	N	N	N	45. Tin	0.8	N	N	N	N
84. Samarium	9	N	N	N	N	62. Titanium	>1,000	>5.6E0	>6.3E0	a	e
60. Scandium	4	3E-3	N	g	N	70. Tungsten	<0.1	<3E-3	N	a	N
54. Selenium	<0.1	<1E0	<2E-2	c	c	85. Uranium	4	3E-2	4E-2	h	c
43. Silicon	>1,000	N	N	N	N	65. Vanadium	110	2.2E1	3.7E1	a	e
79. Silver	<0.1	<2E-1	<1E-1	N	N	Ytterbium	4	N	N	N	N
28. Sodium	>480	N	N	N	N	61. Yttrium	28	N	N	N	N
35. Strontium	140	1.5E0	N	g	N	81. Zinc	31	6.2E-1	1.6E0	c	c
53. Elemental Sulfur	6	N	N	N	N	63. Zirconium	310	N	N	N	N
						Total Discharge Severity		1.6E3	3.1E3		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-36. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR DESILTING POND SEDIMENT LEACHATE

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
10^3 - 10^4				
			Health	
10^2 - 10^3			Ames	Negative
10 - 10^2			CHO (EC_{50})	>600 µl/ml; nontoxic
1 - 10	Mn	Mn	**Ecological**	
			** Aquatic Bioassay - Fish (LD_{50}, 96-hr.)	>100%; nontoxic
			** Aquatic Bioassay - Invertebrate (EC_{50}, 48-hr.)	
			** Aquatic Bioassay - Alga; moderate effect	
			● EC_{50}, 12-day	20.5%
			● EC_{50}, 17-day	28.5%
			● EC_{50}, 21-day	29.0%

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* The chemical results are a combination of ICP and spark source data.

** Composite of desilting pond sediment, transfer pond sediment, and runoff pond sediment leachates.

TABLE 5-37. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DESILTING POND SEDIMENT LEACHATE

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	3,271	3.6E-2	3.8E-2	a	e
50. Antimony	<10	<1.3E-3	<5.0E-2	a	c	71. Manganese	845	3.4E0	8.5E0	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	25	5.0E-3	1.0E-2	c	c	69. Molybdenum	<2	<3E-5	<3E-4	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	<5	<2E-2	<5E-1	a	c
37. Boron	36	7.7E-4	1.4E-3	a	c	29. Potassium	<800	<2.7E-2	<1.7E-2	a	a
82. Cadmium	<2	<4E-2	<2E0	c	c	54. Selenium	NR				
34. Calcium	6,730	N	N	N	N	79. Silver	<30	<1.2E-1	<6E0	c	c
68. Chromium	<2	<8E-3	<8E-3	c	c	28. Sodium	10,354	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	43	9.3E-4	N	g	N
78. Copper	<2	<4E-4	<4E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	Interference					62. Titanium	<1	<1E-5	<1E-3	a	e
72. Iron	<10	N	N	N	N	65. Vanadium	<1	<4E-4	<7E-3	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	<1	<3E-3	<3E-3	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	<50	<2E-2	<1E0	c	e	Palladium	<2	N	N	N	N
49. Arsenic	<2	<8E-3	<4E-2	c	c	48. Phosphorus	<800	N	N	N	N
51. Bismuth	<2	<3E-4	N	a	N	77. Platinum	<2	N	N	N	N
58. Bromine	10	N	N	N	N	84. Praseodymium	<2	N	N	N	N
84. Cerium	<2	N	N	N	N	Rhenium	<2	N	N	N	N
31. Cesium	<1	N	N	N	N	75. Rhodium	<2	N	N	N	N
57. Chlorine	100	N	N	N	N	30. Rubidium	<5	N	N	N	N
84. Dysprosium	<2	N	N	N	N	73. Ruthenium	<2	N	N	N	N
Erbium	<2	N	N	N	N	84. Samarium	<2	N	N	N	N
Europium	<2	N	N	N	N	60. Scandium	<3	<4E-6	N	g	N
56. Fluorine	≈1	N	N	N	N	54. Selenium	<3	<6E-2	<1E-1	c	c
Gadolinium	<2	N	N	N	N	43. Silicon	<800	N	N	N	N
44. Germanium	<2	<2E-4	N	a	N						
80. Gold	<2	N	N	N	N	53. Sulfur	2,920	N	N	N	N
64. Hafnium	<2	N	N	N	N	67. Tantalum	<2	N	N	N	N
Holmium	<2	N	N	N	N	55. Tellurium	<2	<1E-3	N	a	N
59. Iodine	3	N	N	N	N	Terbium	<2	N	N	N	N
Iridium	<2	N	N	N	N	41. Thallium	<2	<1E-3	N	a	N
84. Lanthanum	<2	N	N	N	N	85. Thorium	<20	<3.3E-4	<4.0E-2	h	N
Lutecium	<2	N	N	N	N	Thulium	<2	N	N	N	N
83. Mercury	<0.4	<5E-2	<2E-3	c	c	70. Tungsten	<2	<1E-4	N	a	N
84. Neodymium	<2	N	N	N	N	85. Uranium	<12	<2.0E-4	<2.4E-2	h	c
66. Niobium	<1	N	N	N	N	Ytterbium	<2	N	N	N	N
Osmium	<2	N	N	N	N	63. Zirconium	<4	N	N	N	N
						Total Discharge Severity =		4.1E0	2.0E1		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

The health-related biological tests are negative for the Ames assay and nontoxic for the CHO assay (EC_{50} >600 µl/ml). The ecological-related biological tests were performed on a composite of desilting pond sediment, transfer pond sediment,and runoff pond sediment leachates. The results showed little or nondetectable effects for fish and invertebrates but a moderate effect on algae with EC_{50} values of 20.5 percent, 28.5 percent, and 29.0 percent for 12-, 17-, and 21-day exposures, respectively.

The TCO and Grav analyses for extractable organics showed no detectable concentrations for both the desilting pond sediment and the leachate sample.

5.2.4.6 Transfer Pond Sediment and Transfer Pond Sediment Leachate--

Table 5-38 summarizes the SAM/1A evaluation of the inorganic constituents and the bioassay tests results for transfer pond sediment. As indicated, the health-based TDS has a value of 1,232 with chromium (DS = 190) and manganese (DS = 780) as the major contributors. The ecological-based TDS is approximately 8,050 with phosphorus having an individual discharge severity value of 8,000. Table 5-39 presents the individual DS values for all other components.

The health-related biological effects tests on the sediments reveal a negative response to the Ames assay and a high cellular effect on the RAM assay. Ecological-related biological tests were not performed.

For the transfer pond sediment leachate, the health-based TDS is less than one, and the ecological-based TDS is less than 12. The ecological-based TDS value is derived from four compounds and elements that were below detection limits, so the potential for hazard is indeterminate. The SAM/1A evaluation for inorganics is summarized in Table 5-40. The specific DS values for each element are presented in Table 5-41.

The health-related biological assessment for the leachate sample produced a negative response for the Ames assay and a low or nondetectable response for the CHO clonal assay (EC_{50} >600 µl/ml). The ecological-related biological tests were performed on a composite sample and are discussed in Section 5.2.4.5.

TABLE 5-38. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR TRANSFER POND SEDIMENT

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$		P		
			Health	
$10^2 - 10^3$	Cr, Mn		Ames	Negative
$10 - 10^2$	As, Ba, Cd, Pb, Li Ni, P, V	Mn	RAM(EC_{50})*	1.0 µg/ml; toxic (% phagocytosis)
				0.32 µl/ml (nmol ATP/well)
			Ecological	
1 - 10	Al, Be, Cu, Mg, Se Sr, Ti, Zn	Ba, Cd, Cr, Cu Pb, Ni, Ti, V, Zn	Not conducted.	

---

* Composite of desilting pond sediment and transfer pond sediment.

TABLE 5-39. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR TRANSFER POND SEDIMENT

MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>190	>1.2E0	>9.5E-1	a	c	39. Gallium	14	1.5E2	9.3E-2	d	
47. Ammonia	NR			c	e	44. Germanium	1	17E1	6E-2		
50. Antimony	0.7	5E-2	2E-2	a	c	80. Gold	<0.1				
49. Arsenic	9	2E1	9E-1	c	c	64. Hafnium	5				
36. Barium	900	9.0E1	1.8E0	c	c	Holmium	2				
32. Beryllium	0.3	5E0	3E-2	a	c	59. Iodine	2				
51. Bismuth	<0.1	<8E-3	N	g	N	Iridium	<0.1				
37. Boron	45	4.8E-1	9.0E-3	a	c	72. Iron	>1,000				
58. Bromine	4	N	N	N	N	84. Lanthanum	88				
82. Cadmium	1	1E1	5E0	d	c	46. Lead	15	3E1	2E0	c	c
34. Calcium	>1,000	N	N	N	N	27. Lithium	7	1E1	9E-2	a	c
84. Cerium	110	N	N	N	N	Lutecium	0.2				
31. Cesium	3	N	N	N	N	33. Magnesium	>1,000	>5.6E0	>5.7E-2	a	e
57. Chlorine	27	N	N	N	N	71. Manganese	390	7.8E2	2.0E1	c	c
68. Chromium	97	1.9E2	1.9E0	c	c	83. Mercury	0.01	5E-1	2E-4	c	c
74. Cobalt	≤0.3	≤2E-1	≤6E-3	a	c	69. Molybdenum	2	1E-2	1E-3	a	e
78. Copper	11	1.1E0	1.1E0	a	a	84. Neodymium	21				
84. Dysprosium	4	N	N	N	N	76. Nickel	17	3.8E1	8.5E0	a	c
Erbium	2	N	N	N	N	66. Niobium	44				
Europium	1	N	N	N	N	Osmium	<0.1				
56. Fluorine	≃270	N	N	N	N	Palladium	<0.1				
Gadolinium	5	N	N	N	N	48. Phosphorus	820	2.7E1	8E3	a	c

TABLE 5-39. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR TRANSFER POND SEDIMENT

(Continued)

MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.1					67. Tantalum	<0.1				
29. Potassium	<0.1					55. Tellurium	0.6	2E-1		a	
84. Praseodymium	10					Terbium	0.8				
Rhenium	<0.1					41. Thallium	<0.1	<3E-2		a	
75. Rhodium	<0.1					85. Thorium	20	1.7E-1	2.0E-1	h	c
30. Rubidium	73					Thulium	0.2				
73. Ruthenium	<0.1					45. Tin	2				
84. Samarium	10					62. Titanium	>1,000	>5.6E0	>6.3E0	a	e
60. Scandium	5	3E-3		g		70. Tungsten	1	3E-2		a	
54. Selenium	<0.1	1E0	2E-2	c	c	85. Uranium	7	6E-2	7E-2	h	c
43. Silicon	>1,000					65. Vanadium	64	1.3E1	2.1E0	a	e
79. Silver	<0.1	2E-1	1E-2	c	c	Ytterbium	2				
28. Sodium	>480					61. Yttrium	62				
35. Strontium	140	1.5E0		g		81. Zinc	56	1.1E0	2.8E0	c	c
53. Elemental Sulfur	59					63. Zirconium	310				
						Total Discharge Severity		1.2E3	8.1E3		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-40. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR TRANSFER POND SEDIMENT LEACHATE

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	No health-related discharge severity values greater than 1.			
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$			CHO (EC_{50})	>600 µl/ml; nontoxic
			Ecological	
1 - 10		(Ag)	** See desilting Pond sediment leachate results.	

* The chemical results are a combination of ICP and spark source analyses.

** Composite of desilting pond sediment, transfer pond sediment, and runoff pond sediment leachates.

( )Analytical results indicate possible contamination.

TABLE 5-41. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR TRANSFER POND SEDIMENT LEACHATE

ICP DATA

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	8,031	8.9E-2	9.2E-2	a	e
50. Antimony	<10	<1.3E-3	<5.0E-2	a	c	71. Manganese	8	3E-2	8E-2	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	60	1.2E-2	2.4E-2	c	c	69. Molybdenum	<2	<3E-5	<3E-4	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	<5	<2E-2	<5E-1	a	c
37. Boron	23	4.9E-4	9.2E-4	a	c	29. Potassium	1,900	6.3E-2	4.4E-2	a	a
82. Cadmium	<2	<4E-2	<2E0	c	c	54. Selenium	NR				
34. Calcium	32,900	N	N	N	N	79. Silver	<30	<1.2E-1	<6E0	c	c
68. Chromium	<2	<8E-3	<8E-3	c	c	28. Sodium	9,454	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	177	3.8E-3		g	N
78. Copper	<1	<2E-4	<2E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	Interference			g		62. Titanium	<1	<1E-5	<1E-3	a	e
72. Iron	<10	N	N	N	N	65. Vanadium	<1	<4E-4	<7E-3	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	<2	<6E-3	<5E-3	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	<50	<2.0E-2	<1.0E0	c	e	Palladium	2				
49. Arsenic	<2	<8E-3	<4E-2	c	c	48. Phosphorus	<800	N	N	N	N
51. Bismuth	<2	<3E-4	N	a	N	77. Platinum	<2	N	N	N	N
58. Bromine	10	N	N	N	N	84. Praseodymium	<3	N	N	N	N
84. Cerium	20	N	N	N	N	Rhenium	<2	N	N	N	N
31. Cesium	<2	N	N	N	N	75. Rhodium	<2	N	N	N	N
57. Chlorine	200	N	N	N	N	30. Rubidium	<2	N	N	N	N
84. Dysprosium	<2	N	N	N	N	73. Ruthenium	<2	N	N	N	N
Erbium	<2	N	N	N	N	84. Samarium	<2	N	N	N	N
Europium	<2	N	N	N	N	60. Scandium	<3	<4E-6	N	g	N
56. Fluorine	≃3	N	N	N	N	54. Selenium	<4	<8E-2	<2E-1	c	c
Gadolinium	2	N	N	N	N	43. Silicon	<800	N	N	N	N
44. Germanium	<2	<2E-4	N	a	N						
80. Gold	<2	N	N	N	N	53. Sulfur	620	N	N	N	N
64. Hafnium	<2	N	N	N	N	67. Tantalum	<2	N	N	N	N
Holmium	<2	N	N	N	N	55. Tellurium	<2	<1E-3	N	a	N
59. Iodine	3	N	N	N	N	Terbium	<2	N	N	N	N
Iridium	<2	N	N	N	N	41. Thallium	<2	<1E-3	N	a	N
84. Lanthanum	20	N	N	N	N	85. Thorium	<20	<3.3E-4	<4.0E-2	h	c
Lutecium	<2	N	N	N	N	Thulium	<2	N	N	N	N
83. Mercury	<0.5	<5E-2	<2E-3	c	c	70. Tungsten	<2	<1E-4	N	a	N
84. Neodymium	<2	N	N	N	N	85. Uranium	<12	<2.0E-4	<2.4E-2	h	c
66. Niobium	<1	N	N	N	N	Ytterbium	<2	N	N	N	N
Osmium	<2	N	N	N	N	63. Zirconium	<4	N	N	N	N
						Total Discharge Severity =		8.1E-1	1.2E1		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

Consistent with the desilting pond sediment samples, the TCO and Grav analyses for extractable organics showed no detectable concentration for both the transfer pond sediment and the leachate sample.

5.2.4.7 Runoff Pond Sediment and Runoff Pond Sediment Leachate--

The health-based and ecological-based TDS values as determined by the SAM/1A evaluation are 1,700 and 10,070, respectively. As indicated in Tables 5-42, manganese, with an individual DS value of 1,300, is the highest DS value within the health-based TDS. Phosphorus, with a DS value of 10,000, is the major contributor to the ecological based TDS. Table 5-43 presents individual discharge severity values for all the compounds found within the runoff pond sediment sample.

The health-related biological effects tests showed a negative response for the Ames assay but a high cellular effect for the RAM assay (EC_{50} is 0.83 μg/ml). Ecological-related biological effects tests were not performed.

For the runoff pond sediment leachate samples, the health-based TDS is approximately 41 and the ecological-based TDS is 33. The only determinate component within the health-and ecological-based TDS values with a DS greater than one was manganese. Tables 5-44 and 5-45 present the results of the SAM/1A evaluation of inorganics and the ecological effects tests.

The health-related biological effects tests showed a negative response for the Ames assay and low or nondetectable effects for the CHO clonal assay (EC_{50} >600 μl/ml). The ecological-related biological tests were performed on a composite sample and are discussed in Section 5.2.4.5.

Again, the TCO and Grav analyses for extractable organics showed no detectable concentrations for both the runoff pond sediment and the leachate sample.

5.2.4.8 Filtered Solids from Desilting Pond Water--

The SAM/1A evaluation results and biological test results for this sample are summarized in Tables 5-46 and 5-47. The health-based TDS values are approximately 65 with two elements, manganese and magnesium, having DS values greater than one. Mercury has a DS value of <3E1. The ecological-based TDS value is 41 with only phosphorus having a DS value greater than one.

TABLE 5-42. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR RUNOFF POND SEDIMENT

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$	Mn	P		
			Health	
$10^2 - 10^3$	Ba		Ames	Negative
$10 - 10^2$	As, Cd, Cr, Pb, Li Ni, P, V	Cd, Ni, Mn	RAM(EC_{50})	0.83 µl/ml; toxic (% phagocytosis) 0.79 µl/ml (nmol ATP/well)
			Ecological	
1 - 10	Al, Be, Cu, Mg, Se Sr, Ti, Zn	As, Ba, Cu, Pb Ti, V, Zn	Not conducted.	

TABLE 5-43. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR RUNOFF POND SEDIMENT

MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>190	>1.2E0	>9.5E-1	a	c	39. Gallium	28	1.9E-1	N	d	N
47. Ammonia	NR			c	e	44. Germanium	1	6E-2	N	a	N
50. Antimony	0.7	5E-2	2E-2	a	c	80. Gold	<0.1	N	N	N	N
49. Arsenic	16	3.2E1	1.6E0	c	c	64. Hafnium	37	N	N	N	N
36. Barium	>1,000	>1.0E2	>2E0	c	c	Holmium	2	N	N	N	N
32. Beryllium	0.1	2E0	9E-3	a	c	59. Iodine	2	N	N	N	N
51. Bismuth	<0.1	<8E-3	N	g	N	Iridium	<0.1	N	N	N	N
37. Boron	2	2E-2	4E-4	a	c	72. Iron	>1,000	N	N	N	N
58. Bromine	16	N	N	N	N	84. Lanthanum	160	N	N	N	N
82. Cadmium	6	6E1	3E1	d	c	46. Lead	15	3E1	2E0	c	c
34. Calcium	>1,000	N	N	N	N	27. Lithium	12	1.7E1	1.6E-1	a	c
84. Cerium	110	N	N	N	N	Lutecium	0.9	N	N	N	N
31. Cesium	3	N	N	N	N	33. Magnesium	>1,000	>5.6E0	>5.7E-2	a	e
57. Chlorine	27	N	N	N	N	71. Manganese	640	1.3E3	3.2E1	c	c
68. Chromium	22	4.4E1	4.4E-1	c	c	83. Mercury	0.01	5E-1	2E-4	c	c
74. Cobalt	0.6	4E-1	1E-2	a	c	69. Molybdenum	2	1E-2	1E-3	a	e
78. Copper	11	1.1E0	1.1E0	a	a	84. Neodymium	21	N	N	N	N
84. Dysprosium	4	N	N	N	N	76. Nickel	35	7.8E1	1.8E1	a	c
Erbium	2	N	N	N	N	66. Niobium	44	N	N	N	N
Europium	1	N	N	N	N	Osmium	<0.1	N	N	N	N
56. Fluorine	≃270	N	N	N	N	Palladium	<0.1	N	N	N	N
Gadolinium	6	N	N	N	N	48. Phosphorus	>1,000	>3.3E1	>1E4	a	c

TABLE 5-43. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR RUNOFF POND SEDIMENT

(Continued)

MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.1	N	N	N	N	67. Tantalum	≤0.7	N	N	N	N
29. Potassium	>1,000	N	N	N	N	55. Tellurium	<0.1	<3E-2	N	a	N
84. Praseodymium	10	N	N	N	N	Terbium	0.8	N	N	N	N
Rhenium	<0.1	N	N	N	N	41. Thallium	<0.1	<3E-2	N	a	N
75. Rhodium	<0.1	N	N	N	N	85. Thorium	20	1.7E-1	2.0E-1	h	c
30. Rubidium	160	N	N	N	N	Thulium	0.6	N	N	N	N
73. Ruthenium	<0.1	N	N	N	N	45. Tin	1	N	N	N	N
84. Samarium	10	N	N	N	N	62. Titanium	>1,000	>5.6E0	>6.3E0	a	e
60. Scandium	11	6.9E-3	N	g	N	70. Tungsten	≤1	≤3E-2	N	a	N
54. Selenium	<0.1	<1E0	<2E-2	c	c	85. Uranium	17	1.4E-1	1.7E-1	h	c
43. Silicon	>1,000	N	N	N	N	65. Vanadium	57	1.1E1	1.9E0	a	e
79. Silver	<0.1	<2E-1	<1E-2	c	c	Ytterbium	4	N	N	N	N
28. Sodium	>480	N	N	N	N	61. Yttrium	62	N	N	N	N
35. Strontium	310	3.4E0	N	g	N	81. Zinc	56	1.1E0	2.8E0	c	c
53. Elemental Sulfur	150	N	N	N	N	63. Zirconium	>1,000	N	N	N	N
						Total Discharge Severity		1.7E3	1.0E4		

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-44. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR RUNOFF POND SEDIMENT LEACHATE

Discharge Severity Range	Compounds Found From Chemical Analysis*		Bioassay Test Results	
	Health	Ecological		
10^3 - 10^4				
			Health	
10^2 - 10^3			Ames	Negative
10 - 10^2		Mn	CHO(EC_{50})	>600 µl/ml; nontoxic
			Ecological	
1 - 10	Mn	(Ag)	** See desilting pond sediment leachate results.	

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* The chemical results are a combination of ICP and spark source analyses.

** Composite of desilting pond sediment, transfer pond sediment, and runoff pond sediment leachates.

( ) Analytical results indicate possible contamination.

TABLE 5-45. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR RUNOFF POND SEDIMENT LEACHATES

MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ℓ)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
ICP DATA											
38. Aluminum	<10	<1.3E-4	<1.0E-2	a	c	33. Magnesium	6,501	7.2E-2	7.5E-2	a	e
50. Antimony	<10	<1.3E-3	<5.0E-2	a	c	71. Manganese	2,088	8.4E0	2.1E1	c	c
49. Arsenic	NR					83. Mercury	NR				
36. Barium	82	1.6E-2	3.3E-2	c	c	69. Molybdenum	<2	<3E-5	<3E-4	a	e
32. Beryllium	<1	<3E-2	<2E-2	a	c	76. Nickel	<5	<2E-2	<5E-1	a	c
37. Boron	13	2.8E-4	5.2E-4	a	c	29. Potassium	1,600	5.3E-2	3.7E-2	a	a
82. Cadmium	<2	<4E-2	<2E0	c	c	54. Selenium	NR				
34. Calcium	21,600	N	N	N	N	79. Silver	<30	<1.2E-1	<6E0	c	c
68. Chromium	<2	<8E-3	<8E-3	c	c	28. Sodium	2,054	N	N	N	N
74. Cobalt	<2	<3E-3	<8E-3	c	c	35. Strontium	92	2.0E-3	N	g	N
78. Copper	<1	<2E-4	<2E-2	c	c	45. Tin	<10	N	N	N	N
39. Gallium	Interference					62. Titanium	<1	<1E-5	<1E-3	a	e
72. Iron	<10	N	N	N	N	65. Vanadium	<1	<4E-4	<7E-3	a	e
46. Lead	<50	<2.0E-1	<1.0E0	c	c	61. Yttrium	<1	N	N	N	N
27. Lithium	<1	<3E-3	<3E-3	a	c	81. Zinc	<50	<2.0E-3	<5.0E-1	c	c
SSMS DATA											
47. Ammonia	<90	<3.6E-2	<1.8E0	c	e	Palladium	<1	N	N	N	N
49. Arsenic	<3	<1E-2	<6E-2	c	c	48. Phosphorus	<800	N	N	N	N
51. Bismuth	<1	<2E-4	N	a	N	77. Platinum	<1	N	N	N	N
58. Bromine	40	N	N	N	N	84. Praseodymium	<1	N	N	N	N
84. Cerium	<1	N	N	N	N	Rhenium	<1	N	N	N	N
31. Cesium	<1	N	N	N	N	75. Rhodium	<1	N	N	N	N
57. Chlorine	100	N	N	N	N	30. Rubidium	<1	N	N	N	N
84. Dysprosium	<1	N	N	N	N	73. Ruthenium	<1	N	N	N	N
Erbium	<1	N	N	N	N	84. Samarium	<1	N	N	N	N
Europium	<1	N	N	N	N	60. Scandium	<2	<3E-6	N	g	N
56. Fluorine	≈99	N	N	N	N	54. Selenium	<2	<4E-2	<8E-2	c	c
Gadolinium	<1	N	N	N	N	43. Silicon	3,200	N	N	N	N
44. Germanium	<1	<1E-4	N	a	N						
80. Gold	<1	N	N	N	N	53. Sulfur	>9,920	N	N	N	N
64. Hafnium	<1	N	N	N	N	67. Tantalum	<1	N	N	N	N
Holmium	<1	N	N	N	N	55. Tellurium	<1	<7E-4	N	a	N
59. Iodine	<2	N	N	N	N	Terbium	<1	N	N	N	N
Iridium	<1	N	N	N	N	41. Thallium	<1	<7E-4	N	a	N
84. Lanthanum	<1	N	N	N	N	85. Thorium	<10	<1.7E-4	<2.0E-2	h	c
Lutecium	<1	N	N	N	N	Thulium	<1	N	N	N	N
83. Mercury	<0.5	<5E-2	<2E-3	c	c	70. Tungsten	<1	<7E-5	N	a	N
84. Neodymium	<1	N	N	N	N	85. Uranium	<2	<3E-5	<4E-3	h	c
66. Niobium	<1	N	N	N	N	Ytterbium	<1	N	N	N	N
Osmium	<1	N	N	N	N	63. Zirconium	<1	N	N	N	N

Total Discharge Severity = 4.1E1 3.3E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available

TABLE 5-46. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR FILTERED SOLIDS FROM DESILTING POND WATER

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$	Mn	P	RAM(EC_{50})	166 μg/ml; moderate effect; (% phagocytosis) 218 μl/ml (nmol ATP/well)
			Ecological	
1 - 10	Mg		Not conducted.	

TABLE 5-47. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DESILTING POND FILTERED SOLIDS (109-01)

MEG Category	Estimated Concentration (μg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>3	>2E-2	>2E-2	a	c	39. Gallium	0.1	7E-4	N	d	N
47. Ammonia	NR			c	e	44. Germanium	<0.006	<4E-4	N	a	N
50. Antimony	0.02	1E-3	5E-4	a	c	80. Gold	<0.006	N	N	N	N
49. Arsenic	0.06	1E-1	6E-3	c	c	64. Hafnium	<0.003	N	N	N	N
36. Barium	*			c	c	Holmium	<0.006	N	N	N	N
32. Beryllium	<0.006	<1E-1	<5E-4	a	c	59. Iodine	0.06	N	N	N	N
51. Bismuth	<0.006	<5E-4	N	g		Iridium	<0.006	N	N	N	N
37. Boron	<25	<3E-1	<5.0E-3	a	c	72. Iron	<63	N	N	N	N
58. Bromine	1	N	N	N	N	84. Lanthanum	1		N	N	N
82. Cadmium	<0.006	<6E-2	<3E-2	d	c	46. Lead	0.3	6E-1	3E-2	c	c
34. Calcium	*	N	N	N	N	27. Lithium	0.03	4E-2	4E-5	a	c
84. Cerium	0.4	N	N	N	N	Lutecium	<0.006	N	N	N	N
31. Cesium	0.06	N	N	N	N	33. Magnesium	>57	>3E0	>3E-3	a	e
57. Chlorine	1	N	N	N	N	71. Manganese	13	3E1	7E-1	c	c
68. Chromium	0.6	1E-1	2E-3	c	c	83. Mercury	<0.6	<3E1	<1E-2	c	c
74. Cobalt	<0.006	<4E-3	<1E-4	a	c	69. Molybdenum	0.04	3E-4	3E-5	a	e
78. Copper	0.1	1E-2	1E-2	a	a	84. Neodymium	<0.06	N	N	N	N
84. Dysprosium	<0.006	N	N	N	N	76. Nickel	0.1	2E-1	5E-2	a	c
Erbium	<0.006	N	N	N	N	66. Niobium	<3	N	N	N	N
Europium	<0.006	N	N	N	N	Osmium	<0.006	N	N	N	N
56. Fluorine	≈13	N	N	N	N	Palladium	<0.006	N	N	N	N
Gadolinium	<0.006	N	N	N	N	48. Phosphorus	4	1E-1	4E1	a	c

TABLE 5-47. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR DESILTING POND FILTERED SOLIDS

(Continued)

MEG Category	Estimated Concentration (μg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.006	N	N	N	N	67. Tantalum	<0.01	N	N	N	N
29. Potassium	>38	N	N	N	N	55. Tellurium	<0.006	<2E-3	N	a	N
84. Praseodymium	<0.006	N	N	N	N	Terbium	<0.006	N	N	N	N
Rhenium	<0.006	N	N	N	N	41. Thallium	<0.006	<2E-3	N	a	N
75. Rhodium	<0.006	N	N	N	N	85. Thorium	<0.1	<8E-4	<1E-3	h	c
30. Rubidium	0.3	N	N	N	N	Thulium	<0.006	N	N	N	N
73. Ruthenium	<0.006	N	N	N	N	45. Tin	<0.03	N	N	N	N
84. Samarium	<0.01	N	N	N	N	62. Titanium	32	2E-1	2E-1	a	e
60. Scandium	<0.04	<3E-5	N	g	N	70. Tungsten	<0.006	<2E-4	N	a	N
54. Selenium	<0.04	<4E-1	<8E-3	c	c	85. Uranium	<0.03	<3E-4	<3E-4	h	c
43. Silicon	*	N	N	N	N	65. Vanadium	0.6	1E-1	2E-2	a	e
79. Silver	<0.006	<1E-2	<6E-4	c	c	Ytterbium	<0.006	N	N	N	N
28. Sodium	>6	>4E-3	N	N	N	61. Yttrium	0.1	N	N	N	N
35. Strontium	3	3E-2	N	g	N	81. Zinc	*			c	c
53. Elemental Sulfur	5	N	N	N	N	63. Zirconium	1	N	N	N	N

Total Discharge Severity = 6.5E1 4.1E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available
* = Element is a major component of both blank and sample.

Only health-related biological effects tests were performed on the filtered pond water. The Ames assay produced negative results, but the RAM assay produced a moderate effect (EC_{50} is 166 µg/ml).

Extractable organics analysis was not performed on the filtered solids sample.

5.2.4.9 Filtered Solids from Transfer Pond Water--

The health-based and ecological-based TDS values as determined by the SAM/1A evaluation are approximately 405 and 60, respectively. The relatively high health-based TDS is due to mercury, with an individual DS value of 400. The only constituent with a DS value of greater than one in the ecological-based TDS is phosphorus (see Tables 5-48 and 5-49).

The health-related biological test performed on this sample is the Ames assay which produced negative results.

Extractable organics analysis was not performed on the filtered solids sample.

5.2.4.10 Filtered Solids from Runoff Pond Water--

Table 5-50 summarizes the results of the SAM/1A evaluation and the health-related biological effects tests. The health-based TDS value is approximately 42 with manganese as the only component with a DS value greater than one, although mercury had a DS value of <3E1. The ecological based TDS is approximately 31 and phosphorus is the only component with a DS value greater than one. The individual DS values for all components are presented in Table 5-51.

The biological effects tests show negative for the Ames assay and low or nondetectable effects for the RAM assay (EC_{50} is 300 µg/ml).

Extractable organics analysis was not performed on the filtered solids sample.

5.2.5 Additional Chemical/Physical Tests--

Tables 5-52 through 5-56 list the proximate and ultimate analyses for the run-of-mine coal, clean coal (whole), clean coal (crushed), fine refuse (dewatered), and coarse refuse, respectively. As expected the clean coal

TABLE 5-48 SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR FILTERED SOLIDS FROM TRANSFER POND WATER.

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$	Hg		Ames	Negative
$10 - 10^2$		P		
			Ecological	
1 - 10	Cr, Pb, Ni		Not conducted.	

TABLE 5-49. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR TRANSFER POND FILTERED SOLIDS (110-01)

MEG Category	Estimated Concentration (μg/ g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>6	>4E-2	>3E-2	a	c	39. Gallium	0.1	7E-4	N	d	N
47. Ammonia	NR			c	e	44. Germanium	<0.02	<1E-3	N	a	N
50. Antimony	0.02	1E-3	5E-4	a	c	80. Gold	<0.02	N	N	N	N
49. Arsenic	0.02	4E-2	2E-3	c	c	64. Hafnium	<0.02	N	N	N	N
36. Barium	*			c	c	Holmium	<0.02	N	N	N	N
32. Beryllium	<0.02	<3E-1	<2E-3	a	c	59. Iodine	<0.1	N	N	N	N
51. Bismuth	<0.02	<2E-3	N	g		Iridium	<0.02	N	N	N	N
37. Boron	>5	>5E-2	>1E-3	a	c	72. Iron	108	N	N	N	N
58. Bromine	11	N	N	N	N	84. Lanthanum	0.3	9E-5	N	N	N
82. Cadmium	<0.02	<2E-1	<1E-1	d	c	46. Lead	<0.5	<1E0	<5E-2	c	c
34. Calcium	*	N	N	N	N	27. Lithium	<0.03	<4E-2	<4E-4	a	c
84. Cerium	<0.5	N	N	N	N	Lutecium	<0.02	N	N	N	N
31. Cesium	0.03	N	N	N	N	33. Magnesium	>138	>8E-1	>8E-3	a	e
57. Chlorine	2	N	N	N	N	71. Manganese	<0.1	<2E-1	<5E-3	c	c
68. Chromium	0.5	1E0	1E-2	c	c	83. Mercury	8	4E2	2E-1	c	c
74. Cobalt	<0.03	<2E-2	<6E-4	a	c	69. Molybdenum	<0.05	<3E-4	<4E-5	a	e
78. Copper	0.6	6E-2	6E-2	a	a	84. Neodymium	<0.02	N	N	N	N
84. Dysprosium	<0.02	N	N	N	N	76. Nickel	0.5	1E0	3E-1	a	c
Erbium	<0.02	N	N	N	N	66. Niobium	<6	N	N	N	N
Europium	<0.02	N	N	N	N	Osmium	<0.02	N	N	N	N
56. Fluorine	<31	N	N	N	N	Palladium	<0.02	N	N	N	N
Gadolinium	<0.02	N	N	N	N	48. Phosphorus	6	2E-1	6E1	a	c

TABLE 5-49. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR TRANSFER POND FILTERED SOLIDS

(Continued)

MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (μg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.02	N	N	N	N	67. Tantalum	<0.03	N	N	N	N
29. Potassium	>62	N	N	N	N	55. Tellurium	<0.02	<7E-3	N	a	N
84. Praseodymium	<0.06	N	N	N	N	Terbium	<0.02	N	N	N	N
Rhenium	<0.02	N	N	N	N	41. Thallium	<0.02	<7E-3	N	a	N
75. Rhodium	<0.02	N	N	N	N	85. Thorium	<0.1	<8E-4	<1E-3	h	c
30. Rubidium	0.3	N	N	N	N	Thulium	<0.02	N	N	N	N
73. Ruthenium	<0.02	N	N	N	N	45. Tin	<0.03	N	N	N	N
84. Samarium	<0.02	N	N	N	N	62. Titanium	3	2E-2	2E-2	a	e
60. Scandium	<0.02	<1E-5	N	g	N	70. Tungsten	<0.02	<7E-4	N	a	N
54. Selenium	<0.06	<6E-1	<1E-2	c	c	85. Uranium	<0.06	<5E-4	<6E-4	h	c
43. Silicon	*	N	N	N	N	65. Vanadium	0.5	1E-1	2E-2	a	e
79. Silver	<0.02	<4E-2	<2E-3	c	c	Ytterbium	<0.02	N	N	N	N
28. Sodium	>14	N	N	N	N	61. Yttrium	<0.2	N	N	N	N
35. Strontium	0.2	2E-3	N	g	N	81. Zinc	*			c	c
53. Elemental Sulfur	2	N	N	N	N	63. Zirconium	0.2	N	N	N	N

Total Discharge Severity = 4.1E2 6.1E1

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available
* = Element is a major component of both blank and sample.

TABLE 5-50. SUMMARY OF CHEMICAL AND BIOASSAY TEST RESULTS FOR FILTERED SOLIDS FROM RUNOFF POND WATER

Discharge Severity Range	Compounds Found From Chemical Analysis		Bioassay Test Results	
	Health	Ecological		
$10^3 - 10^4$				
			Health	
$10^2 - 10^3$			Ames	Negative
$10 - 10^2$	Mn,	P	RAM(EC_{50})	300 μg/ml; nontoxic (% phagocytosis)
				400 μl/ml (nmol ATP/well)
			Ecological	
$1 - 10$			Not conducted.	

TABLE 5-51. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR RUNOFF POND FILTERED SOLIDS

MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
38. Aluminum	>3	>2E-2	>2E-2	a	c	39. Gallium	0.05	3E-4	N	d	N
47. Ammonia	NR			c	e	44. Germanium	<0.006	<4E-4	N	a	N
50. Antimony	0.006	4E-4	2E-4	a	c	80. Gold	<0.006	N	N	N	N
49. Arsenic	0.006	1E-2	6E-4	c	c	64. Hafnium	<0.01	N	N	N	N
36. Barium	*			c	c	Holmium	<0.006	N	N	N	N
32. Beryllium	<0.006	<1E-1	<5E-4	a	c	59. Iodine	0.06	N	N	N	N
51. Bismuth	<0.006	<5E-4	N	q	N	Iridium	<0.006	N	N	N	N
37. Boron	>19	>2E-1	>4E-3	a	c	72. Iron	44	N	N	N	N
58. Bromine	0.3	N	N	N	N	84. Lanthanum	0.2	N	N	N	N
82. Cadmium	<0.006	<6E-2	<3E-2	d	c	46. Lead	0.2	4E-1	2E-2	c	c
34. Calcium	>63	N	N	N	N	27. Lithium	0.05	7E-2	7E-4	a	c
84. Cerium	<0.2	N	N	N	N	Lutecium	<0.006	N	N	N	N
31. Cesium	0.01	N	N	N	N	33. Magnesium	>57	>3.2E-1	>3.3E-3	a	e
57. Chlorine	2	N	N	N	N	71. Manganese	6	1E1	3E-1	c	c
68. Chromium	0.1	2E-1	2E-3	c	c	83. Mercury	<0.6	<3E1	<1E-2	c	c
74. Cobalt	<0.006	<4E-3	<1E-4	a	c	69. Molybdenum	0.1	7E-4	7E-5	a	e
78. Copper	0.3	3E-2	3E-2	a	a	84. Neodymium	<0.03	N	N	N	N
84. Dysprosium	<0.006	N	N	N	N	76. Nickel	0.2	4E-1	1E-1	a	c
Erbium	<0.006	N	N	N	N	66. Niobium	3	N	N	N	N
Europium	<0.006	N	N	N	N	Osmium	<0.006	N	N	N	N
56. Fluorine	≈6	N	N	N	N	Palladium	<0.006	N	N	N	N
Gadolinium	<0.006	N	N	N	N	48. Phosphorus	3	1E-1	3E1	a	c

TABLE 5-51. SUMMARY OF TEST RESULTS AND DISCHARGE SEVERITY VALUES FOR RUNOFF POND FILTERED SOLIDS

(Continued)

MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value		MEG Category	Estimated Concentration (µg/g)	Discharge Severity (Estimated Conc/ DMEG Conc)		Basis for Mate Value	
		Health	Ecological	Health	Ecological			Health	Ecological	Health	Ecological
77. Platinum	<0.006	N	N	N	N	67. Tantalum	<0.04	N	N	N	N
29. Potassium	>25	N	N	N	N	55. Tellurium	<0.006	<2E-3	N	a	N
84. Praseodymium	<0.03	N	N	N	N	Terbium	<0.006	N	N	N	N
Rhenium	<0.006	N	N	N	N	41. Thallium	<0.006	<2E-3	N	a	N
75. Rhodium	<0.006	N	N	N	N	85. Thorium	<0.04	<3E-4	<4E-4	h	c
30. Rubidium	0.2	N	N	N	N	Thulium	<0.006	N	N	N	N
73. Ruthenium	<0.006	N	N	N	N	45. Tin	<0.02	N	N	N	N
84. Samarium	<0.01	N	N	N	N	62. Titanium	1	6E-3	6E-3	a	e
60. Scandium	<0.01	<6E-6	N	g	N	70. Tungsten	<0.006	<2E-4	N	a	N
54. Selenium	<0.03	<3E-1	<6E-3	c	c	85. Uranium	<0.03	<3E-4	<3E-4	h	c
43. Silicon	*	N	N	N	N	65. Vanadium	<0.2	<4E-2	<7E-3	a	e
79. Silver	<0.006	<1E-2	<6E-4	c	c	Ytterbium	<0.006	N	N	N	N
28. Sodium	>6	N	N	N	N	61. Yttrium	<0.3	N	N	N	N
35. Strontium	1	1E-2	N	g	N	81. Zinc	*			c	c
53. Elemental Sulfur	<1	N	N	N	N	63. Zirconium	0.1	N	N	N	N

a = TLV
b = TLM, lowest
c = most stringent criteria
d = carcinogenicity
e = LC_{50}
f = NIOSH recommendation
g = LD_{50}
h = regulations for protection against radiation
i = lowest concentration reported to produce effects in vegetation
N = DMEG value is not available
* = Element is a major component of both blank and sample.

TABLE 5-52. PROXIMATE AND ULTIMATE ANALYSES OF ROM COAL

Proximate Analysis	As Received	Dry Basis
Percent moisture	3.87	---
Percent ash	28.66	29.81
Percent volatile	31.68	32.96
Percent fixed carbon	35.79	37.23
	100.00	100.00
Btu	9,657	10,046
Percent sulfur	4.35	4.52

	Percent Weight	
Ultimate Analysis	As Received	Dry Basis
Moisture	3.87	---
Carbon	53.93	56.10
Hydrogen	3.79	3.94
Nitrogen	1.23	1.28
Chlorine	0.08	0.08
Sulfur	4.35	4.52
Ash	28.66	29.81
Oxygen (diff)	4.09	4.27
	100.00	100.00

TABLE 5-53. PROXIMATE AND ULTIMATE ANALYSES OF WHOLE CLEAN COAL

Proximate Analysis	As Received	Dry Basis
Percent moisture	4.14	---
Percent ash	12.74	13.29
Percent volatile	36.62	38.20
Percent fixed carbon	46.50	48.51
	100.00	100.00
Btu	12,120	12,643
Percent sulfur	2.79	2.91

	Percent Weight	
Ultimate Analysis	As Received	Dry Basis
Moisture	4.14	---
Carbon	67.61	70.53
Hydrogen	4.64	4.84
Nitrogen	1.28	1.34
Chlorine	0.08	0.08
Sulfur	2.79	2.91
Ash	12.74	13.29
Oxygen (diff)	6.72	7.01
	100.00	100.00

TABLE 5-54. PROXIMATE AND ULTIMATE ANALYSES OF CRUSHED CLEAN COAL

Proximate Analysis	As Received	Dry Basis
Percent moisture	2.55	---
Percent ash	12.72	13.05
Percent volatile	38.34	39.34
Percent fixed carbon	46.39	47.61
	100.00	100.00
Btu	12,401	12,725
Percent sulfur	2.98	3.06

	Percent Weight	
Ultimate Analysis	As Received	Dry Basis
Moisture	2.55	---
Carbon	68.90	70.70
Hydrogen	4.78	4.90
Nitrogen	1.40	1.44
Chlorine	0.08	0.08
Sulfur	2.98	3.06
Ash	12.72	13.05
Oxygen (diff)	6.59	6.77
	100.00	100.00

TABLE 5-55. PROXIMATE AND ULTIMATE ANALYSES OF DEWATERED FINE REFUSE

Proximate Analysis	As Received	Dry Basis
Percent moisture	2.40	---
Percent ash	55.36	56.72
Percent volatile	19.20	19.67
Percent fixed carbon	23.04	23.61
	100.00	100.00
Btu	5,906	6,051
Percent sulfur	1.27	1.30

	Percent Weight	
Ultimate Analysis	As Received	Dry Basis
Moisture	2.40	---
Carbon	34.66	35.51
Hydrogen	2.18	2.23
Nitrogen	0.59	0.60
Chlorine	0.04	0.04
Sulfur	1.27	1.30
Ash	55.36	56.72
Oxygen (diff)	3.50	3.60
	100.00	100.00

TABLE 5-56. PROXIMATE AND ULTIMATE ANALYSES OF COARSE REFUSE

Proximate Analysis	As Received	Dry Basis
Percent moisture	2.52	
Percent ash	65.50	67.19
Percent volatile	19.77	20.28
Percent fixed carbon	12.21	12.53
	100.00	100.00
Btu	4,078	4,183
Percent sulfur	8.03	8.24

	Percent Weight	
Ultimate Analysis	As Received	Dry Basis
Moisture	2.52	---
Carbon	22.84	23.43
Hydrogen	1.64	1.68
Nitrogen	0.56	0.57
Chlorine	0.03	0.03
Sulfur	8.03	8.24
Ash	65.50	67.19
Oxygen (diff)	-1.12	-1.14
	100.00	100.00

has a 35 percent lower sulfur content and 26 percent greater energy content. On a lb $SO_2/10^6$ Btu basis, the clean coal has an equivalent emission of 4.60 vs. 9.01 for ROM coal, a 49 percent reduction.

The results of the water quality analyses performed on water from the filtered desilting, transfer, and runoff ponds and ROM coal storage pile runoff are compared to the most stringent state effluent water regulations for eastern and midwestern states as stated in the Bureau of National Affairs, Environment Reporter State Water Laws.(35) These comparisons, shown in Table 5-57, identified that all water quality parameters for each of these waste streams met the most stringent state effluent regulations.

For those waste streams that could potentially enter the ground water (i.e., runoff flows and solids leachates), the applicable water quality parameters were compared to the Extraction Procedure Toxicity Concentrations of the Resource Conservation and Recovery Act (RCRA).(36) These EP Toxicity Concentrations are the determining criteria for classifying wastes as hazardous and nonhazardous. Table 5-58 shows that the concentration of all constituents in the applicable waste streams are well below the levels specified by the RCRA Extraction Procedure Toxicity Concentrations. Please note that the leachates were prepared using the ASTM Proposed Method for Leaching Waste Materials (see Section 4.1.1.16) and not the RCRA procedure.

Table 5-59 shows that upwind particulates consist mostly of quartz dust, with up to 10 percent calcite, identified by reaction with hydrochloric acid. The particle load on the coarse size filters was notably lower than in-plant samples. Samples taken downwind of open piles and the plant show higher concentrations of coal dust, especially in the size ranges 15 to 7.2 microns and 7.2 and 3 microns. The coarse samples from the rotary breaker (RB) consist of nearly 50 percent coal dust, as may be expected. Downwind particulates show higher concentrations of coal dust than upwind.

Particle morphology was fairly typical of aeolian-transported grains. Quartz grains were mostly subangular and smooth surfaced. The softer coal grains were usually subrounded with typical vitreous luster.

TABLE 5-57. SUMMARY OF WATER QUALITY PARAMETERS FOR LIQUID STREAMS (mg/ℓ)

Water Quality Parameter	Fine Refuse Slurry Filtrate	Desilting Pond Water Filtrate	Transfer Pond Water Filtrate	Runoff Pond Water Filtrate	ROM Coal Storage Pile Runoff	Most Stringent State Effluent Regulation (mg/ℓ)	States Having* Most Stringent Regulation
Cl^-	15	15	10	15	25	1,500**	WV
F^-	0.4	0.65	0.60	0.3	1.5	15	IL
SO_4=	125	150	140	65	125	3,375**	IN
S_3=	NC	NC	NC	NC	NC	None	
Total Phosphorus	0.6	0.06	0.2	0.2	0.1	1.0	IL,IN,MI,OH
Ammonia - N	<0.1	<0.1	<0.1	<0.1	<0.1	2.5/4.0***	IL
Nitrite - N	NC	NC	NC	NC	NC	None	
Nitrate - N	0.7	0.8	0.5	0.5	1.5	150**	OH
COD	18.2	7.3	7.3	10.9	21.9	None	
BOD	<18.2+	<1.0+	<1.0+	1.9+	--	30	IL,KY

* Based on Northern Appalachian, Eastern, and Midwest Coal Producing States (i.e., IL, IN, KY, MI, MD, OH, PA, and WV)

** Based on Surface Water Quality Standard x 15

*** 2.5 is applicable for April to October; 4.0 is applicable for November to March

NC Not computed

+ Analysis performed on an unfiltered sample

TABLE 5-58. ESTIMATED CONCENTRATIONS OF POTENTIAL POLLUTANTS IN RUNOFF AND SOLIDS LEACHATES* COMPARED TO RCRA EXTRACTION PROCEDURE TOXICITY STANDARDS (mg/ℓ)

	Estimated Concen-tration ROM Coal Leachate	Estimated Concen-tration Clean Coal Leachate	Estimated Concen-tration Coarse Ref. Leachate	Estimated Concen-tration Desilting Pond Sediment Leachate	Estimated Concen-tration Transfer Pond Sediment Leachate	Estimated Concen-tration Runoff Pond Sediment Leachate	Estimated Concen-tration ROM Storage Pile Runoff	RCRA EP Toxicity Standards
pH	7.4	7.8	7.5	7.2	7.9	7.5	7.2	2.0 - 12.5
Arsenic	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003	0.01	5.0
Barium	0.051	0.090	0.050	0.025	0.060	0.082	0.038	100.0
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	1.0
Chromium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.011	5.0
Lead	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	5.0
Mercury	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0002	0.2
Selenium	<0.002	<0.005	<0.006	<0.003	<0.004	<0.002	0.03	1.0
Silver	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	5.0

* Deionized water leaching.

TABLE 5-59. SUMMARY OF PARTICULATE MORPHOLOGY DATA

	Size Range, μ					
Sample Location	15-7.2	7.2-3	3-1.5	1.5-0.95	0.95-0.49	<0.49
Upwind	26/65	10/90	10/90	20/70	25/75	5/95
RB	50/40*	50/50*	20/50	20/80	30/70	20/80
ROMSP	35/40*	35/45*	20/80	15/85	15/85	15/80
Downwind	35/65*	35/65*	15/85	20/80	40/60*	5/95

KEY

- Ratios are percentages of coal/quartz in sample.
- RB = rotary breaker.
- ROMSP = run-of-mine storage pile.
- Ratio's totalling <100% have remainder made up of calcite.

* Ratios with ≥35% coal.

SECTION 6.0

QUALITY ASSURANCE AND QUALITY CONTROL

The basic Versar Quality Assurance (QA) and Quality Control (QC) program ensures that information generated for any project is both accurate and precise and is technically sound and legally defensible. Elements of this control program include:

- Documentation of all data collected both by Versar and subcontractors.
- Assessment of data accuracy and representativeness, identification and documentation of discrepancies and uncertainties, and development of resolution plants.
- Sampling and laboratory QA/QC programs.
- Technical and independent review of work by senior professionals and regular management review of all quality control procedures.

Versar's Quality Control Program is coordinated by a Quality Assurance staff for both the analytical laboratory operations and engineering operations. In addition, the Quality Assurance staff provides external quality control by use of on-site system surveys, independent performance audits, inter-laboratory comparisons, and periodic evaluation of analytical and engineering quality control procedures.

The Quality Assurance program is divided into four basic divisions including, Engineering Analysis Quality Control, Sampling Quality Control, Analytical Chemistry Quality Control, and Report Quality Control. A brief summary of the QC components within the program are presented below.

6.1 ENGINEERING ANALYSIS QUALITY CONTROL PROGRAM

This program includes an information control system which ensures the following:

- All activities are represented in an identifiable form, and all documents are maintained in a centralized record file.
- Engineering worksheets and calculations are verified and sampled.
- The environmental assessment data base has a zero-error computer input.

6.2 SAMPLING QUALITY CONTROL PROGRAM

Versar's Sampling Quality Control Program applies to all portions of the sampling analysis, including:

- Uniformity of sample collection procedures.
- Sample control.
- Equipment control.
- Recordkeeping - detailing procedures carried out and problems encountered in the field.
- Summary reports detailing these activities and problems.

6.3 VERSAR ANALYTICAL LABORATORY QUALITY CONTROL PROGRAM

The Versar Analytical Quality Control Program (VAQCP) is equivalent to the Quality Control Program in daily use at the EPA Region V Control Regional Laboratory. The purpose of the VAQCP is to obtain real-time data on the precision, accuracy, and recovery of each analyzed parameter. It ensures accountability, data quality, and traceability and, as a result, validates all results. The VAQCP is based on the periodic analysis and interpretation of results of spiked samples and spiked sample duplicators, as well as maintenance, calibrations, and monitoring of the quality of various materials used in the analytical procedures.

The VAQCP consists of three basic elements including documentation, instrument calibration, and analysis controls.

6.3.1 Documentation

A batch control number is assigned to each shipment of samples received by Versar for analysis. All work performed on a batch is documented in the following logbooks for purposes cited:

- Sample receiving logbook - to log the samples when they are received and assign a batch number.
- Extraction logbook - to record the sample preparation and analysis done on every batch.
- Instrument logbook - to record the use and maintenance of gas chromatographic detectors, columns, and other instruments.
- Standards logbook - to record the preparation and use of all the standards in the laboratory.
- QC logbook - to record all the day-to-day QC data obtained from the analysis of a batch.
- Chemist's notebook - to record the raw data and final data for every batch.

6.3.2 Instrument Calibration

Prior to analysis of samples, the analytical instrument is calibrated using at least three standards that cover the working range of the method. The standards are equally spaced throughout the operating concentration range. The slope, intercept, and correlation coefficient for each calibration curve is recorded in the QC logbook. The correlation coefficient should be better than 0.995. If not, a new calibration curve is prepared.

Each day, if operation is continuous, or before analyzing each batch of samples if operation is non-continuous, a minimum of two check standards are analyzed to establish the validity of the original calibration curve. Check standards represent the range of the original calibration curve, i.e., one above and one below the mid-point of the calibration curve. If these check standards fall outside the established limits, a new calibration curve is prepared.

6.3.3 Controls

To obtain data on the precision, accuracy, and recovery on each batch of samples, the following control samples are analyzed:

- Reagent blank - to check for laboratory contamination.
- Method standard - to check the accuracy of the method, under optimum conditions, excluding any chemical interference from sample matrix.
- Duplicate sample (i.e., replicates) - to check the laboratory precision and provide a measure for analytical error.
- Spiked sample - to check the recovery of parameter of interest, including any chemical interference from the sample matrix.

In addition to the four control samples, commercial reference standards are also analyzed bi-annually for parameter of interest. The data obtained from these analyses are recorded in the QC logbook.

In summary, the QC logbook contains the following information:

- Precision data from duplicate analyses.
- Accuracy data from method standards.
- Accuracy data from spiked sample analysis.
- Accuracy data from reference standards.
- Check of contamination from reagent blank analysis.
- Detection of limits of the method.
- Recovery from spiked sample analysis.
- Slope, intercept, and correlation coefficient of calibration curve.

6.4 REPORT QUALITY CONTROL

All reports generated at Versar are subjected to four levels of quality control. After completion of the first draft of a report, a review is performed by an independent technical staff member and appropriate revisions are made. Next the report is reviewed by the program manager followed by a review by the staff editor. Finally all reports are reviewed by Versar's Vice President and Division Manager or his designee.

6.5 SUBCONTRACTOR QUALITY CONTROL

In addition to facilitating the QC effort of in-house activities, Versar's QA staff interacts with the subcontractor(s) to ensure that their data meets the standards of the Versar QA/QC program and customer requirements. This includes, as required, submission by Versar to the subcontractor of duplicate samples, and spiked and method standards. In cases where the validity of data is in question, Versar's analytical laboratory analyzes duplicate or split samples by alternate, equivalent methods,or samples are sent to independent laboratories for analysis.

As part of our Quality Assurance program, Quality Control samples, including two reagent blanks, (4) solids (S) and (3) liquids (L) were submitted blind to CT and E for SSMS elemental analysis. These are listed in Table 6-1. Of 313 elements analyzed, 175 or 83 percent were considered within the ±300 percent accuracy limits set by level 1 testing procedures and 37 or 17 percent were considered to exceed the limit. Twenty-five fell in the range of 300 to 600 percent and 12 were >600 percent. For the two reagent blanks (number 186-01 and 188-01), 52 of 64 elements were measured to be below 100 ppb.

ERCO (Energy Resources Co., Inc.) was judged to have adequate internal Quality Control procedures that were included in their report. However, ERCO has not established acceptable protocols for submittal of external Quality Control samples by outside contractors.

6.6 QUALITY ASSURANCE AND QUALITY CONTROL: LEVEL 1 ENVIRONMENTAL ASSESSMENT

A program of suitable laboratory techniques, quality control, and quality assurance is required for Level 1 Assessments. Versar's QA/QC program meets or exceeds the requirements specified in the "Procedures Manual for Level 1 Environmental Assessment."

As specified in the "Procedures Manual for Level 1 Environmental Assessment," the goal of the Level 1 sampling and analysis program is to acquire environmental assessment data having an accuracy factor of 3.(34)

TABLE 6-1. QUALITY CONTROL SAMPLES SUBMITTED TO CTE FOR SSMS ELEMENTAL ANALYSIS

		Number Elements		
Sample No.	Sample Description	In	Out	Total
187-01	EPA Reference Standard (L)	12	1	13
189-01	Duplicate of 174-01 (L)	32	6	38
190-01	NBS Coal 1632 (S)	25	3	28
191-01	Duplicate of 102-01 S	42	6	48
192-01	Mag 1, USGS S	17	6	23
193-01	Duplicate 106-01 S	39	10	49
194-01	Methods Standard (Versar) L	8	5	13
		175	37	212
		83%	17%	

Generally nothing is known about the composition of samples of this type. As a result, the analyst may not recognize artificial results except by comparison to analytical controls or does not know what precautions to take to maintain sample integrity. In addition, since Level 1 Environmental Assessment samples are not taken in duplicate and generally cannot be split into aliquots without changing the effective limits of detection, the analyst must obtain all information with one sample. As a result, the usual statistical approaches to obtain precision (replicate analysis) and accuracy (independently verified true values) cannot be rigorously applied. Thus, precision and accuracy will normally be dependent on calibration standards. Analysts typically aim for precision, expressed as a coefficient of variation, of about ten percent for each quantitative operation.

All of Versar's in-house sampling and analysis efforts were carried out according to specifications and protocols outlined in this report. Additional QA/QC efforts were necessary based on results of the initial quality control results from the subcontractor for spark source elemental analysis of liquid samples. Consistent with the above discussion, Versar's analytical laboratories analyzed split liquid samples using an inductively coupled plasma optical emission spectrometer for metal analysis. The results from both methods are provided in Appendices A and B.

Because of the specialized nature of the bioassay techniques, an assessment of selected protocols used by the biological subcontractor were made by external consultants and found to meet the requirements of Level 1.

SECTION 7.0

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations, by sample media, from the source test and evaluation of coal preparation plant No. 2 are presented in this section. A summary of the multimedia chemical and biological stream characteristics and control strategy recommendations are provided in Table 1-1.

7.1 FUGITIVE EMISSIONS

The fugitive particulate samples showed relatively high total ambient concentrations and low TDS values. The ambient TSP values were highest around the ROM coal pile and rotary breaker, as expected, because of the continual coal handling activities in those area. When the high ambient air TSP value (i.e., upwind value) was subtracted from the downwind results, the contribution to the ambient air 600 m downwind from the preparation plant can be estimated at 70 $\mu g/m^3$. Although 600 m downwind is still within the plant boundary, the 70 $\mu g/m^3$ can be compared to the 24-hour primary and secondary ambient air quality standards for TSP of 260 $\mu g/m^3$ and 150 $\mu g/m^3$, respectively. Consistently, no fugitive particulate sample had a total discharge severity value greater than 0.01.

The TCO + grav analyses of fugitive vapors were determined to be low after subtracting out the upwind contribution. In fact, the TCO + grav samples for the rotary breaker and ROM coal storage pile are less than the upwind value. It can be concluded that the preparation plant and ROM coal pile contribute little gaseous matter to the environment. The TDS value for vapors ranged from 6.7 to 12 based on health criteria and 0.0 to 0.9 for ecological criteria. Chromium and nickel are the only elements with DS values greater than or equal to one. However, for two of the nickel concentrations and two of the chromium concentrations, the DS value can be attributed to concentrations within the XAD-2 resin blank.

The TDS values show a low potential for hazard; however, the bioassay results for the RAM test indicate a potential hazard.

As shown in Table 5-59, the high downwind TSP loading combined with the particulate morphology results indicate that dust in the plant area is being transported. Better dust control/suppression techniques would minimize much of the downwind TSP contribution.

The results do not support the need for further study during the Level 2 Environmental Assessment phase.

7.2 LIQUIDS

7.2.1 Fine Waste Slurry Filtrate

This liquid stream was generated by filtering the fine waste refuse slurry. It has a low health-based TDS of 2 and a high, potentially harmful ecological-based TDS of 10. Considering that the waste stream contained fine coal particles before filtration, the organics concentration of 300 μg/ℓ is very low.

7.2.2 Pond Water Filtrates

Again these liquid streams were generated by filtering the desilting, transfer, and runoff pond waters. According to the SAM/1A evaluation for inorganic constituents, trace elements were at low concentrations based on health effects (i.e., TDS = 1.4 to 2.6). However, there is a relatively higher potential for hazardous effects on an ecological basis (i.e., TDS = 8 to 18). The pond water filtrates consistently show ammonia, cadmium, manganese, and nickel to be the significant contributors to the ecological-based TDS.

The runoff pond water contains several more constituents (than the desilting and transfer pond waters) with DS values greater than one. This is expected because the runoff pond collects all storm water runoff from the surrounding areas of the plant property including the storage piles and haul roads.

Biological tests were performed on unfiltered pond water samples. The majority of individual biological tests for health-related responses were negative (i.e., low hazard potential) for the Ames assay, the Rodent Acute In Vivo test, the CHO assay, and the aquatic bioassays. Moderate effects, however, were produced by the desilting pond water for both the CHO assay and the aquatic bioassay with algae.

There were no detectable chromatographable organics. Gravimetrically determined extractable organics for the pond waters ranged from 300 to 400 μg/ℓ.

When compared to the most stringent state effluent regulations for states in the Eastern Midwest and Northern Appalachian coal regions, the pond waters complied with every regulation. The pond waters at this plant are not discharged, but potentially could be.

7.2.3 ROM Coal Pile Runoff

Similar to the pond waters, the inorganic constituent SAM/1A evaluation showed a low potential hazard for health-based criteria with a TDS of 2.0 and a relatively higher potential for ecological-based criteria with a TDS of approximately 16. The significant inorganic and trace element compounds contributing to the ecological-based TDS are ammonia, cadmium, chromium, nickel, and silver.

The health-related biological assessments, consistent with the inorganic analysis, show negative results for the Ames assay and nontoxic cellular effects for the CHO clonal assay.

The ROM coal pile runoff sample consisted of no detectable chromatographable or gravimetrically determined organics.

The water quality parameters in the runoff sample complied with both the most stringent state effluent regulations studied, and with the RCRA EP toxicity guideline values (Tables 5-57 and 5-58).

7.2.4 Summary and Recommendations

The results show ammonia having a discharge severity value greater than one, on either a health or ecological basis in all liquid waste streams. It is recommended that the protocol for analyzing ammonia be changed to include the use of standards (to verify results) to determine if the ammonia is a result of interference during analysis or if the origin of the ammonia is from coal mining activities.

The presence of cadmium, manganese, nickel, and silver in the liquid waste streams is not unexpected. These metals are found in the coal and are not produced by preparation.

These results support the need for further characterization during the Level 2 Environmental Assessment phase.

7.3 SOLIDS AND LEACHATE WASTE STREAMS

7.3.1 Fine Refuse Slurry (Dewatered)

The health-based TDS for fine refuse solids is 492, with As, Ba, Be, Cd, Cr, Pb, Mn, P, and V being major contributors. The ecological-based TDS was higher at 10,000 with only phosphorus as the major contributor.

The health-related bioassay effects tests were performed on the raw slurry sample. The Ames test produced negative results and the Rodent Acute In Vivo test showed low or nondetectable effects. However, the CHO assay showed a high cellular effect (EC_{50} µl/ml) and there were moderate effects to the aquatic bioassay with algae, resulting in EC_{50} values at 11.0 percent, 13.5 percent, and 11.0 percent sample concentrations for 12-, 17-, and 21-day exposure periods, respectively. The aquatic bioassays with fish and invertebrates resulted in low or nondetectable effects from the slurry.

7.3.2 Coarse Refuse and Coarse Refuse Leachate

The TDS values for the coarse refuse are 2,069 and 10,088 based on health and ecological criteria, respectively. Contributors to the health TDS are As, Ba, Be, Cd, Cr, Cu, Pb, Li, Mg, Mn, Hg, Ni, P, and Ti. For the ecological TDS, Pb, Mn, Ni, P, and Se were the contributors. Phosphorus was the major contributor with a DS value three orders of magnitude greater than the other elements.

The Ames and RAM assays for coarse refuse indicated negative or nondetectable effects.

In contrast to the refuse itself, the coarse refuse leachate had a health-based TDS of 10 and an ecological-based TDS of 200. Manganese and ammonia were the only elements with DS values greater than one for the health TDS, while ammonia, cadmium, manganese, nickel, and silver also contributed to the ecological TDS.

The extractable organics concentrations were below the detection limit of 1.0 mg/ℓ for both chromatographable and gravimetric analyses.

The health-related bioassay tests on the leachate showed low or nondetectable effects (i.e., Ames and CHO clonal assays). The ecological-related biological effects test was conducted on a leachate composite and is presented separately.

The applicable water quality parameters in the coarse refuse leachate samples complied with the RCRA EP Toxicity Standards (Tables 5-57 and 5-58).

7.3.3 ROM Coal and ROM Coal Leachate

Consistent with the coarse refuse sample, the ROM coal produced low or nondetectable effects for both the Ames assay and the RAM test. The health-based TDS of 4 and the ecological-based TDS of 67 are an order of magnitude lower than the coarse refuse leachate. Manganese is the only element with a DS value greater than one. As with the ecological-based TDS for the coarse refuse leachate, Cd, Mn, Ni, NH_3-N, and Ag have DS values greater than one.

Health-related bioassays on the leachate revealed low or nondetectable effects for the Ames and CHO clonal assays. The ecological-related bioassays are presented separately, as coal and coarse refuse leachate samples were composited for those tests.

As with the coarse refuse leachate, the water quality parameters in the ROM coal leachate sample complied with the RCRA EP Toxicity Standards (Tables 5-57 and 5-58).

7.3.4 Clean Coal and Clean Coal Leachate

Consistent with the other coal samples, the clean coal produced low or nondetectable effects for the Ames and RAM assays.

Compared with the two solids leachates discussed above, the health- and ecological-based TDS values for inorganics were the lowest. The health-based TDS of 2.2 had no elements with a DS value greater than one. The ecological-based TDS of 35 again had NH_3-N, Cd, Mn, Ni, and Ag with DS values greater than or equal to one.

The clean coal leachate health-related bioassays (i.e., Ames and CHO clonal) indicated no biological responses.

As with the previous leachate samples, no water quality parameters were found to exceed the RCRA EP Toxicity Standards (Tables 5-57 and 5-58).

7.3.5 ROM Coal Leachate, Clean Coal Leachate, and Coarse Refuse Leachate Composite

The leachates from coal and coarse refuse materials were composited for the aquatic biological assessments. The results showed low or non-detectable effects from the composite on the fish and invertebrates. A moderate effect, however, was indicated on the algae. The leachate composite produced EC_{50} values for 25.0 percent, 32.0 percent, and 33.0 percent sample concentrations for 12-, 17-, and 21-day exposure periods, respectively.

7.3.6 Desilting Pond, Transfer Pond, and Runoff Pond Sediment and Sediment Leachates

The health-based TDS values for the sediments are 1,628, 1,232, and 428 from the desilting transfer and runoff ponds, respectively. The desilting pond and transfer pond sediments were consistent in that both had the same elements with DS values greater than ten. Those elements are As, Ba, Cd, Cr, Pb, Li, Mn, Ni, P, and V. For the runoff pond sediment Ba, As, Cd, Pb, Li, Ni, P, and V have DS values greater than ten. The ecological-based TDS values are 3,091, 8,054, and 10,068. In all cases the major contributor was phosphorus, with less significant concentrations from manganese, nickel, and vanadium.

The health-related assessment results were negative for each individual Ames test. However, a high cellular effect was shown from the desilting and transfer pond sediment composite, and the runoff pond sediment for the RAM assay.

The sediment leachate results for the health-based TDS are 4.1, 0.84, and 9.2 for the desilting, transfer, and runoff pond sediment leachates, respectively. None of the three health-based TDS values had individual elements with discharge severity values greater than ten. The corresponding ecological-based TDS values are an order of magnitude greater than the health-based TDS values. They are 20, 12, and 33 for desilting, transfer, and runoff sediment leachate samples, respectively. In every sample, the high ecological value is primarily due to phosphorus.

Health related biological effects tests for individual samples showed low or nondetectable responses for the Ames and CHO clonal assays. The aquatic bioassay was performed on a composite of the three leachate samples. The aquatic bioassay of leachate composite resulted in low or nondetectable effects on fish and invertebrates, and moderate effects on algae. The EC_{50} values for the algae test were at 20.5 percent, 28.5 percent, and 29.0 percent sample concentrations for 12-, 17-, and 21-day exposure periods, respectively.

The applicable water quality parameters for the three pond sediment leachate samples were below the RCRA EP Toxicity Standards (Tables 5-57 and 5-58).

7.3.7 Desilting Pond, Transfer Pond, and Runoff Pond Filtered Solids

The health-related TDS values for the filtered solids from the desilting, transfer, and runoff pond waters are 65, 405, and 42, respectively. The ecological-related TDS values are 41, 61, and 30, respectively. For the health-related TDS, Mn and Hg are the major contributors. For the ecological-based TDS, P is the only element with a DS value greater than one. The TDS values are greater for the filtered solids from the transfer pond because the size of the transfer pond is significantly smaller and the concentrations of elements much more concentrated.

7.3.8 Summary and Recommendations

As expected, the pond sediments and fine waste solids had many heavy metal and other elements with discharge severities greater than one and as high as 10,000. These elements originate in the coal and the cleaning process is intended to produce refuse by removing incombustibles from the coal. None of the elements have been changed drastically from their natural state because only mechanical processes are used in the cleaning process. The high concentrations of the elements in the refuse solids does emphasize the concern over ultimate disposal of those wastes and that actions must be taken to avoid the migration of these chemicals to the environment.

Leaching of the elements from the solids and into the ground water is an obvious pathway for migration. The leachates from the ROM coal, clean coal, and coarse refuse have considerably smaller potentials for problems based on ecological effects and little or no problem from the health standpoint. It appears that the coal and coarse refuse leachate tests should have relatively low priority during the Level 2 Environmental Assessment phase.

In contrast, the pond sediment leachates showed a higher potential for problems based on ecological DMEG values and bioassays. Interestingly, the sediment leachate chemical concentrations are much higher than the pond waters which are also in contact with the sediment. This is undoubtedly due to the dilution of pond water by plant influent and rain. Note that the ratio of leachate water to sediments is only 4:1 on a weight basis. Another reason for the concentration difference is that the pH of the ponds range from 7.2 to 7.7. In that pH range, trace elements typically have lower solubilities. It is recommended that the EP Method for testing leachability, described in the RCRA regulations, be used in future Level 1 and 2 Environmental Assessments to investigate the leaching potential under acidic (i.e., worst case) conditions.

Since the heavy metals and trace elements appear in greatest concentrations in the pond sediments and are susceptible to leaching, it is recommended that a better characterization of pond sediments be made during Level 2 testing. The characterization should involve obtaining samples from different sections of the pond and testing sediments at different depths to determine the potential for pollutant migration downward and into the ground water. Wells upgradient and downgradient of the ponds should also be monitored.

7.4 EXTRACTABLE ORGANIC RESULTS

TCO + Grav results are shown on Table 7-1. For the liquid media, the values ranged from 200 to 700 μg/ℓ. In all samples the TCO value was less than the detection limit of 1,000 μg/ℓ. All organic concentrations in these liquids appear to be nonchromatographable. The relatively high gravimetric (i.e., non-volatile) values may be explained by the fact that some inorganic ions do interfere with gravimetric analyses.

The pond sediment values are lower than expected. The TCO + Grav concentrations were all below the detection limit.

The coal, coal refuse, and pond sediment leachate samples also were found to be below the detection limit.

XAD-2 resin organic concentrations are relatively low when compared to the ambient air quality standard for hydrocarbons of 160 $\mu g/m^3$. The highest TCO value measured is for the downwind sample with a concentration of 130 $\mu g/m^3$. The ROM coal pile and rotary breaker TCO concentrations are considered low, 20 $\mu g/m^3$ and 10 $\mu g/m^3$, respectively. The upwind concentration of 90 $\mu g/m^3$ indicates that the coal preparation plant is contributing approximately 40 $\mu g/m^3$ to the environment, a value far below the ambient air quality standard.

The low total organic concentrations in most streams is not surprising since coal preparation is a physical process which does not burn or treat the coal in any manner, except for crushing and washing. No organic solvents or similar materials are used to clean the coal. Since organic material is unlikely to be leached from the coal by washing, the results presented above are consistent with expectations, and no organics controls are needed.

TABLE 7-1. TCO AND GRAV ANALYSIS

Sample Descriptive	TCO (mg)	GRAV (mg)	TCO & GRAV (total mg)	Concentration, mg (m^3, ℓ, kg)
XAD-2 Resins Soxhlet				
ROM coal pile fugitives	<1.0	3.0	3.0	0.02 mg/m^3
Rotary breaker fugitives	<1.0	2.0	2.0	0.01 mg/m^3
Downwind fugitives	14.2	3.0	17.2	0.13 mg/m^3
Upwind fugitives	8.2	2.0	10.2	0.09 mg/m^3
Blank	<1.0	4.0	4.0	0.03 mg/m^3
Field Extracts				
ROM coal pile runoff	<1.0	<1.0	<2.0	<0.2 mg/ℓ
Fine refuse slurry filtrate	<1.0	3.0	3.0	0.3 mg/ℓ
Desilting pond filtrate	<1.0	3.0	3.0	0.3 mg/ℓ
Transfer pond filtrate	<1.0	4.0	4.0	0.4 mg/ℓ
Runoff pond filtrate	<1.0	3.0	3.0	0.3 mg/ℓ
Deionized water	2.7	4.0	6.7	0.7 mg/ℓ
Deionized water + spike	1.0	5.0	6.0	0.6 mg/ℓ
Coal Leachate				
Clean coal	<1.0	<1.0	<2.0	<1.0 mg/ℓ
ROM coal	<1.0	<1.0	<2.0	<1.0 mg/ℓ
Coarse refuse	<1.0	<1.0	<2.0	<1.0 mg/ℓ
Pond Sediment Leachate				
Desilting pond	1.1	1.0	2.1	<1.0 mg/ℓ
Transfer pond	<1.0	<1.0	<2.0	<1.0 mg/ℓ
Runoff pond	1.8	<1.0	1.8	<1.0 mg/ℓ
Pond Sediment Soxhlet				
Desilting pond sediment	<1.0	<1.0	<2.0	<20.0 mg/kg
Transfer pond sediment	<1.0	<1.0	<2.0	<20.0 mg/kg
Runoff pond sediment	<1.0	<1.0	<2.0	<20.0 mg/kg

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APPENDIX A

SPARK SOURCE MASS SPECTROMETER DATA

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 101-01

IAD No.: 97-D663-377-27

Clean Coal (whole) CONCENTRATION IN PPM WEIGHT (µg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	11	Terbium		Ruthenium		Vanadium	61
Thorium	6	Gadolinium		Molybdenum	81	Titanium	MC
Bismuth		Europium		Niobium	* MC	Scandium	2
Lead	24	Samarium	2	Zirconium	42	Calcium	MC
Thallium		Neodymium	3	Yttrium	24	Potassium	MC
Mercury	NR	Praseodymium	4	Strontium	52	Chlorine	46
Gold		Cerium	38	Rubidium	28	Sulfur	MC
Platinum		Lanthanum	34	Bromine	7	Phosphorus	56
Iridium		Barium	870	Selenium	3	Silicon	MC
Osmium		Cesium	4	Arsenic	7	Aluminum	>330
Rhenium		Iodine	2	Germanium	0.7	Magnesium	MC
Tungsten		Tellurium		Gallium	11	Sodium	>830
Tantalum		Antimony		Zinc	21	Fluorine	≈110
Hafnium		Tin	0.7	Copper	20	Oxygen	NR
Lutecium		Indium	STD	Nickel	6	Nitrogen	NR
Ytterbium		Cadmium	0.5	Cobalt	2	Carbon	NR
Thulium		Silver		Iron	MC	Boron	31
Erbium		Palladium		Manganese	66	Beryllium	0.1
Holmium		Rhodium		Chromium	37	Lithium	6
Dysprosium						Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected <0.3 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs caw

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 102-01

IAD No.: 97-D663-377-27

Clean Coal (crushed) CONCENTRATION IN PPM WEIGHT (μg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	8	Terbium		Ruthenium		Vanadium	* 65
Thorium	9	Gadolinium		Molybdenum	24	Titanium	MC
Bismuth		Europium	0.3	Niobium	5	Scandium	1
Lead	31	Samarium	4	Zirconium	14	Calcium	MC
Thallium		Neodymium	2	Yttrium	7	Potassium	MC
Mercury	NR	Praseodymium	3	Strontium	35	Chlorine	120
Gold		Cerium	28	Rubidium	19	Sulfur	MC
Platinum		Lanthanum	18	Bromine	7	Phosphorus	920
Iridium		Barium	230	Selenium	6	Silicon	MC
Osmium		Cesium	1	Arsenic	11	Aluminum	>210
Rhenium		Iodine	3	Germanium	1	Magnesium	980
Tungsten		Tellurium		Gallium	18	Sodium	>550
Tantalum		Antimony	0.7	Zinc	14	Fluorine	≈75
Hafnium		Tin	0.9	Copper	23	Oxygen	NR
Lutecium		Indium	STD	Nickel	4	Nitrogen	NR
Ytterbium		Cadmium	0.7	Cobalt	2	Carbon	NR
Thulium		Silver		Iron	MC	Boron	51
Erbium		Palladium		Manganese	110	Beryllium	0.4
Holmium		Rhodium		Chromium	2	Lithium	3
Dysprosium						Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected <0.2 ppm
MC — Major Component
INT — Interference

Approved: MLJacobs cnm

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 191-01

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

Clean Coal Duplicate (crushed) CONCENTRATION IN PPM WEIGHT (μg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	5	Terbium		Ruthenium		Vanadium	200
Thorium	6	Gadolinium		Molybdenum	15	Titanium	MC
Bismuth		Europium	≤0.4	Niobium	4	Scandium	2
Lead	15	Samarium	2	Zirconium	84	Calcium	MC
Thallium		Neodymium	9	Yttrium	11	Potassium	MC
Mercury	NR	Praseodymium	4	Strontium	52	Chlorine	82
Gold		Cerium	40	Rubidium	28	Sulfur	MC
Platinum		Lanthanum	34	Bromine	7	Phosphorus	250
Iridium		Barium	280	Selenium	4	Silicon	MC
Osmium		Cesium	1	Arsenic	7	Aluminum	>330
Rhenium		Iodine	2	Germanium	1	Magnesium	MC
Tungsten		Tellurium		Gallium	11	Sodium	>830
Tantalum		Antimony	3	Zinc	21	Fluorine	≈51
Hafnium		Tin		Copper	11	Oxygen	NR
Lutetium		Indium	STD	Nickel	11	Nitrogen	NR
Ytterbium		Cadmium	0.6	Cobalt	1	Carbon	NR
Thulium		Silver	11	Iron	MC	Boron	31
Erbium		Palladium		Manganese	130	Beryllium	0.5
Holmium		Rhodium		Chromium	93	Lithium	20
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.3 ppm weight
MC — Major Component
INT — Interference

Approved: M J Jacobs

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 103-01

IAD No.: 97-D663-377-27

Fine Refuse (dewatered) CONCENTRATION IN PPM WEIGHT (μg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	11	Terbium	0.6	Ruthenium		Vanadium	98
Thorium	25	Gadolinium	2	Molybdenum	6	Titanium	MC
Bismuth		Europium	0.6	Niobium	7	Scandium	8
Lead	23	Samarium	7	Zirconium	110	Calcium	MC
Thallium		Neodymium	12	Yttrium	19	Potassium	MC
Mercury	NR	Praseodymium	7	Strontium	93	Chlorine	33
Gold		Cerium	34	Rubidium	110	Sulfur	>810
Platinum		Lanthanum	34	Bromine	1	Phosphorus	MC
Iridium		Barium	620	Selenium	2	Silicon	MC
Osmium		Cesium	9	Arsenic	3	Aluminum	>130
Rhenium		Iodine	0.6	Germanium	0.7	Magnesium	MC
Tungsten		Tellurium	≤0.8	Gallium	19	Sodium	>330
Tantalum		Antimony	1	Zinc	86	Fluorine	≈200
Hafnium		Tin	1	Copper	23	Oxygen	NR
Lutecium		Indium	STD	Nickel	5	Nitrogen	NR
Ytterbium		Cadmium	0.4	Cobalt	1	Carbon	NR
Thulium	<0.1	Silver		Iron	MC	Boron	12
Erbium	0.5	Palladium		Manganese	66	Beryllium	0.2
Holmium	0.7	Rhodium		Chromium	66	Lithium	5
Dysprosium	3					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.1 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs cmw

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 104-01

IAD No.: 97-D663-377-27

ROM Coal CONCENTRATION IN PPM WEIGHT (μg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	15	Terbium	0.4	Ruthenium		Vanadium	64
Thorium	8	Gadolinium	2	Molybdenum	9	Titanium	MC
Bismuth		Europium	1	Niobium	10	Scandium	1
Lead	35	Samarium	4	Zirconium	12	Calcium	MC
Thallium	5	Neodymium	17	Yttrium	6	Potassium	MC
Mercury	NR	Praseodymium	10	Strontium	31	Chlorine	48
Gold		Cerium	44	Rubidium	73	Sulfur	MC
Platinum		Lanthanum	79	Bromine	4	Phosphorus	MC
Iridium		Barium	510	Selenium	6	Silicon	MC
Osmium		Cesium	3	Arsenic	9	Aluminum	>190
Rhenium		Iodine	0.9	Germanium	1	Magnesium	MC
Tungsten		Tellurium		Gallium	6	Sodium	>480
Tantalum		Antimony	1	Zinc	17	Fluorine	≈170
Hafnium	1	Tin	0.8	Copper	21	Oxygen	NR
Lutecium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium	0.6	Cobalt	4	Carbon	NR
Thulium	≤0.1	Silver		Iron	MC	Boron	18
Erbium	0.8	Palladium		Manganese	97	Beryllium	0.1
Holmium	1	Rhodium		Chromium	22	Lithium	7
Dysprosium	2					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs cw

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 105-01

IAD No.: 97-D663-377-27

Coarse Refuse CONCENTRATION IN PPM WEIGHT (μg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	13	Terbium	0.5	Ruthenium		Vanadium	110
Thorium	14	Gadolinium	2	Molybdenum	17	Titanium	MC
Bismuth		Europium	0.4	Niobium	10	Scandium	2
Lead	270	Samarium	8	Zirconium	97	Calcium	MC
Thallium	4	Neodymium	13	Yttrium	22	Potassium	MC
Mercury	NR	Praseodymium	17	Strontium	110	Chlorine	21
Gold		Cerium	88	Rubidium	130	Sulfur	>930
Platinum		Lanthanum	62	Bromine	3	Phosphorus	MC
Iridium		Barium	720	Selenium	18	Silicon	MC
Osmium		Cesium	18	Arsenic	31	Aluminum	>150
Rhenium		Iodine	0.7	Germanium	3	Magnesium	MC
Tungsten		Tellurium	0.3	Gallium	12	Sodium	>380
Tantalum		Antimony	3	Zinc	25	Fluorine	≈230
Hafnium	2	Tin	1	Copper	51	Oxygen	NR
Lutecium		Indium	STD	Nickel	6	Nitrogen	NR
Ytterbium		Cadmium	1	Cobalt	5	Carbon	NR
Thulium	≤0.1	Silver		Iron	MC	Boron	35
Erbium	0.6	Palladium		Manganese	510	Beryllium	0.3
Holmium	0.8	Rhodium		Chromium	43	Lithium	9
Dysprosium	1					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.1 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 106-01

IAD No.: 97-D663-377-27

Desilting Pond Sediment CONCENTRATION IN PPM WEIGHT (µg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	4	Terbium	0.8	Ruthenium		Vanadium	110
Thorium	32	Gadolinium	5	Molybdenum	2	Titanium	MC
Bismuth		Europium	1	Niobium	24	Scandium	4
Lead	15	Samarium	9	Zirconium	310	Calcium	MC
Thallium		Neodymium	17	Yttrium	28	Potassium	MC
Mercury	NR	Praseodymium	8	Strontium	140	Chlorine	9
Gold		Cerium	28	Rubidium	73	Sulfur	6
Platinum		Lanthanum	44	Bromine	2	Phosphorus	330
Iridium		Barium	MC	Selenium		Silicon	MC
Osmium		Cesium	3	Arsenic	10	Aluminum	>190
Rhenium		Iodine	4	Germanium	0.4	Magnesium	MC
Tungsten		Tellurium		Gallium	16	Sodium	>480
Tantalum		Antimony		Zinc	31	Fluorine	≃67
Hafnium	5	Tin	0.8	Copper	11	Oxygen	NR
Lutecium	0.8	Indium	STD	Nickel	8	Nitrogen	NR
Ytterbium	4	Cadmium	≤0.3	Cobalt	0.6	Carbon	NR
Thulium	0.6	Silver		Iron	MC	Boron	8
Erbium	2	Palladium		Manganese	640	Beryllium	<0.1
Holmium	2	Rhodium		Chromium	46	Lithium	7
Dysprosium	4					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 193-01

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

Desilting Pond Sediment Duplicate

CONCENTRATION IN PPM WEIGHT (μg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	7	Terbium	0.8	Ruthenium		Vanadium	110
Thorium	33	Gadolinium	*10	Molybdenum	0.9	Titanium	MC
Bismuth		Europium	1	Niobium	24	Scandium	3
Lead	15	Samarium	10	Zirconium	120	Calcium	MC
Thallium		Neodymium	21	Yttrium	*120	Potassium	MC
Mercury	NR	Praseodymium	8	Strontium	120	Chlorine	11
Gold		Cerium	49	Rubidium	73	Sulfur	6
Platinum		Lanthanum	79	Bromine	1	Phosphorus	820
Iridium		Barium	900	Selenium	2	Silicon	MC
Osmium		Cesium	12	Arsenic	10	Aluminum	>190
Rhenium		Iodine	9	Germanium	0.4	Magnesium	MC
Tungsten	≤1	Tellurium		Gallium	13	Sodium	>480
Tantalum		Antimony		Zinc	56	Fluorine	≈170
Hafnium	10	Tin	2	Copper	11	Oxygen	NR
Lutetium	0.2	Indium	STD	Nickel	20	Nitrogen	NR
Ytterbium	1	Cadmium	1	Cobalt	4	Carbon	NR
Thulium	0.3	Silver	4	Iron	MC	Boron	14
Erbium	*8	Palladium		Manganese	640	Beryllium	0.3
Holmium	*10	Rhodium		Chromium	22	Lithium	27
Dysprosium	*16					Hydrogen	NR

*Heterogeneous

Note: Sample dried under a heat lamp and
ground to -200 mesh prior to analysis.

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm weight
MC — Major Component
INT — Interference

Approved: M Jacobs

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 107-01

IAD No.: 97-D663-377-27

Transfer Pond Sediment CONCENTRATION IN PPM WEIGHT (µg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	7	Terbium	0.8	Ruthenium		Vanadium	64
Thorium	20	Gadolinium	5	Molybdenum	2	Titanium	MC
Bismuth		Europium	1	Niobium	44	Scandium	5
Lead	15	Samarium	10	Zirconium	310	Calcium	MC
Thallium		Neodymium	21	Yttrium	62	Potassium	MC
Mercury	NR	Praseodymium	10	Strontium	140	Chlorine	27
Gold		Cerium	110	Rubidium	73	Sulfur	59
Platinum		Lanthanum	88	Bromine	4	Phosphorus	820
Iridium		Barium	900	Selenium		Silicon	MC
Osmium		Cesium	3	Arsenic	9	Aluminum	>190
Rhenium		Iodine	2	Germanium	1	Magnesium	MC
Tungsten	1	Tellurium	0.6	Gallium	14	Sodium	>480
Tantalum		Antimony	0.7	Zinc	56	Fluorine	≈270
Hafnium	5	Tin	2	Copper	11	Oxygen	NR
Lutecium	0.2	Indium	STD	Nickel	17	Nitrogen	NR
Ytterbium	2	Cadmium	1	Cobalt	≤0.3	Carbon	NR
Thulium	0.2	Silver		Iron	MC	Boron	45
Erbium	2	Palladium		Manganese	390	Beryllium	0.3
Holmium	2	Rhodium		Chromium	97	Lithium	7
Dysprosium	4					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs caw

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 108-01

IAD No.: 97-D663-377-27

Runoff Pond Sediment CONCENTRATION IN PPM WEIGHT (µg/g)

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	17	Terbium	0.8	Ruthenium		Vanadium	57
Thorium	20	Gadolinium	6	Molybdenum	2	Titanium	MC
Bismuth		Europium	1	Niobium	44	Scandium	11
Lead	15	Samarium	10	Zirconium	MC	Calcium	MC
Thallium		Neodymium	21	Yttrium	62	Potassium	MC
Mercury	NR	Praseodymium	10	Strontium	310	Chlorine	27
Gold		Cerium	110	Rubidium	160	Sulfur	150
Platinum		Lanthanum	160	Bromine	16	Phosphorus	MC
Iridium		Barium	MC	Selenium		Silicon	MC
Osmium		Cesium	3	Arsenic	16	Aluminum	>190
Rhenium		Iodine	2	Germanium	1	Magnesium	MC
Tungsten	≤1	Tellurium		Gallium	28	Sodium	>480
Tantalum	≤0.7	Antimony	0.7	Zinc	56	Fluorine	≈270
Hafnium	37	Tin	1	Copper	11	Oxygen	NR
Lutecium	0.9	Indium	STD	Nickel	35	Nitrogen	NR
Ytterbium	4	Cadmium	6	Cobalt	0.6	Carbon	NR
Thulium	0.6	Silver		Iron	MC	Boron	2
Erbium	2	Palladium		Manganese	640	Beryllium	0.1
Holmium	2	Rhodium		Chromium	22	Lithium	12
Dysprosium	4					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved: MLJacobs CRW

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 109-01 Filter

IAD No.: 97-D663-377-27

Desilting Pond Filtered Solids CONCENTRATION IN μg/Total Filter

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.0004	Terbium		Ruthenium		Vanadium	0.009
Thorium	0.002	Gadolinium		Molybdenum	0.001	Titanium	0.5
Bismuth		Europium		Niobium	0.005	Scandium	0.0007
Lead	0.008	Samarium	≤0.0002	Zirconium	0.02	Calcium	MC
Thallium		Neodymium	0.001	Yttrium	0.002	Potassium	>0.6
Mercury	NR	Praseodymium	0.001	Strontium	0.06	Chlorine	0.03
Gold		Cerium	0.01	Rubidium	0.01	Sulfur	0.1
Platinum		Lanthanum	0.02	Bromine	0.02	Phosphorus	0.08
Iridium		Barium	MC	Selenium	0.0006	Silicon	MC
Osmium		Cesium	0.002	Arsenic	0.001	Aluminum	>0.05
Rhenium		Iodine	0.002	Germanium	0.0001	Magnesium	MC
Tungsten	0.001	Tellurium		Gallium	0.002	Sodium	>0.1
Tantalum	≤0.0002	Antimony	0.0004	Zinc	MC	Fluorine	≈0.4
Hafnium	0.0005	Tin	0.0004	Copper	0.003	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.002	Nitrogen	NR
Ytterbium		Cadmium	0.0001	Cobalt	<0.0001	Carbon	NR
Thulium		Silver		Iron	MC	Boron	0.1
Erbium		Palladium		Manganese	0.2	Beryllium	<0.0001
Holmium		Rhodium		Chromium	0.01	Lithium	0.0006
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001 μg/Total Filter
MC — Major Component >1 μg/Total Filter
INT — Interference

Approved: ML Jacobs

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 110-01 Filter

IAD No.: 97-D663-377-27

Transfer Pond Filtered Solids, **CONCENTRATION IN** µg/Total Filter

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.0003	Terbium		Ruthenium		Vanadium	0.003
Thorium	0.0007	Gadolinium		Molybdenum	0.0003	Titanium	0.04
Bismuth		Europium		Niobium	0.0008	Scandium	<0.0001
Lead	0.002	Samarium	≤0.0001	Zirconium	0.005	Calcium	MC
Thallium		Neodymium	0.001	Yttrium	0.001	Potassium	>0.4
Mercury	NR	Praseodymium	0.0004	Strontium	0.01	Chlorine	0.02
Gold		Cerium	0.002	Rubidium	0.007	Sulfur	0.03
Platinum		Lanthanum	0.002	Bromine	0.07	Phosphorus	0.05
Iridium		Barium	MC	Selenium	0.0004	Silicon	MC
Osmium		Cesium	0.001	Arsenic	0.0002	Aluminum	>0.04
Rhenium		Iodine	0.0007	Germanium	<0.0001	Magnesium	MC
Tungsten		Tellurium		Gallium	0.001	Sodium	>0.09
Tantalum	≤0.0002	Antimony	0.0002	Zinc	MC	Fluorine	≈0.1
Hafnium		Tin	0.0002	Copper	0.005	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.003	Nitrogen	NR
Ytterbium		Cadmium	≤0.0001	Cobalt	0.0002	Carbon	NR
Thulium		Silver		Iron	0.7	Boron	>0.7
Erbium		Palladium		Manganese	0.0002	Beryllium	<0.0001
Holmium		Rhodium		Chromium	0.004	Lithium	<0.0001
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001 Total µg/Filter
MC — Major Component > 1 µg/Total Filter
INT — Interference

Approved: MLJacobs

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 111-01

IAD No.: 97-D663-377-27

Runoff Pond Filtered Solids CONCENTRATION IN μg/Total Filter

ELEMENT†	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.0003	Terbium		Ruthenium		Vanadium	0.003
Thorium	0.0007	Gadolinium		Molybdenum	0.002	Titanium	0.04
Bismuth		Europium		Niobium	0.08	Scandium	0.0002
Lead	0.006	Samarium	≤0.0002	Zirconium	0.006	Calcium	2
Thallium		Neodymium	0.0004	Yttrium	0.0005	Potassium	>0.4
Mercury	NR	Praseodymium	0.0005	Strontium	0.03	Chlorine	0.04
Gold		Cerium	0.002	Rubidium	0.008	Sulfur	0.005
Platinum		Lanthanum	0.003	Bromine	0.01	Phosphorus	0.06
Iridium		Barium	MC	Selenium	0.0004	Silicon	MC
Osmium		Cesium	0.001	Arsenic	0.0002	Aluminum	>0.04
Rhenium		Iodine	0.002	Germanium	<0.0001	Magnesium	MC
Tungsten		Tellurium		Gallium	0.001	Sodium	>0.09
Tantalum	≤0.0007	Antimony	0.0002	Zinc	MC	Fluorine	≈0.3
Hafnium	0.0002	Tin	0.0003	Copper	0.005	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.003	Nitrogen	NR
Ytterbium		Cadmium	0.0001	Cobalt	<0.0001	Carbon	NR
Thulium		Silver	0.0001	Iron	0.7	Boron	>0.7
Erbium		Palladium		Manganese	0.1	Beryllium	<0.0001
Holmium		Rhodium		Chromium	0.003	Lithium	0.001
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001 Total μg/Filter
MC — Major Component >1 μg/Total Filter
INT — Interference

Approved: MLJacobs caw

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 183-01 Filter

IAD No.: 97-D663-377-27

Filtered Solids Blank CONCENTRATION IN μg/Total Filter

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.0004	Terbium		Ruthenium		Vanadium	<0.0001
Thorium	<0.0005	Gadolinium		Molybdenum	0.0003	Titanium	0.02
Bismuth		Europium		Niobium	0.04	Scandium	<0.0001
Lead	0.003	Samarium		Zirconium	0.004	Calcium	MC
Thallium		Neodymium		Yttrium	<0.0001	Potassium	>0.7
Mercury	NR	Praseodymium	<0.0001	Strontium	0.009	Chlorine	0.01
Gold		Cerium	0.003	Rubidium	0.005	Sulfur	0.02
Platinum		Lanthanum	0.0005	Bromine	0.005	Phosphorus	0.008
Iridium		Barium	MC	Selenium		Silicon	MC
Osmium		Cesium	0.0008	Arsenic	0.0001	Aluminum	>0.06
Rhenium		Iodine	0.0007	Germanium	<0.0001	Magnesium	0.1
Tungsten		Tellurium		Gallium	0.0002	Sodium	>0.1
Tantalum	≤0.0002	Antimony	0.0001	Zinc	MC	Fluorine	≈0.2
Hafnium		Tin		Copper	0.0008	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.0002	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	<0.0001	Carbon	NR
Thulium		Silver		Iron	0.01	Boron	0.4
Erbium		Palladium		Manganese	0.0007	Beryllium	<0.0001
Holmium		Rhodium		Chromium	0.0006	Lithium	0.0002
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001μg/Total Filter
MC — Major Component > 1μg/Total Filter
INT — Interference

Approved: MLJacobson

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 122-01

IAD No.: 97-D663-377-27

Fine Waste Slurry Filtrate CONCENTRATION IN $\mu g/ml$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.05	Terbium		Ruthenium		Vanadium	0.06
Thorium	<0.06	Gadolinium		Molybdenum	0.09	Titanium	2
Bismuth		Europium		Niobium	0.03	Scandium	≤0.009
Lead		Samarium		Zirconium	0.05	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.3	Chlorine	1
Gold		Cerium	0.04	Rubidium	0.07	Sulfur	MC
Platinum		Lanthanum	0.02	Bromine	0.3	Phosphorus	0.6
Iridium		Barium	0.4	Selenium	0.05	Silicon	MC
Osmium		Cesium		Arsenic	0.02	Aluminum	3
Rhenium		Iodine	0.2	Germanium		Magnesium	3
Tungsten		Tellurium		Gallium	0.02	Sodium	MC
Tantalum	≤0.02	Antimony	0.03	Zinc	0.1	Fluorine	≈0.8
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.3	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.06	Carbon	NR
Thulium		Silver		Iron	5	Boron	6
Erbium		Palladium		Manganese	0.04	Beryllium	
Holmium		Rhodium		Chromium	0.2	Lithium	9
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected <0.007 μg/ml
MC — Major Component > 10 μg/ml
INT — Interference

Approved: MLJacobs

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 124-01

IAD No.: 97-D663-377-27

Desilting Pond Water Filtrate **CONCENTRATION IN** µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.03	Terbium		Ruthenium		Vanadium	0.003
Thorium	<0.03	Gadolinium		Molybdenum	0.03	Titanium	0.02
Bismuth		Europium		Niobium		Scandium	≤0.004
Lead		Samarium		Zirconium	0.006	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.3	Chlorine	0.05
Gold		Cerium		Rubidium	0.003	Sulfur	8
Platinum		Lanthanum		Bromine	0.1	Phosphorus	0.06
Iridium		Barium	0.2	Selenium	≤0.009	Silicon	1
Osmium		Cesium		Arsenic	0.002	Aluminum	0.07
Rhenium		Iodine	0.02	Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium		Sodium	>9
Tantalum		Antimony		Zinc	0.02	Fluorine	≈0.03
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.006	Carbon	NR
Thulium		Silver		Iron	0.09	Boron	0.009
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.005
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.003 µg/ml
MC — Major Component > 10 µg/ml
INT — Interference

Approved: ML Jacobs cmo

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 126-01

IAD No.: 97-D663-377-27

Transfer Pond Water Filtrate CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	0.001
Thorium	<0.03	Gadolinium		Molybdenum	0.08	Titanium	0.04
Bismuth		Europium		Niobium		Scandium	≤0.004
Lead		Samarium		Zirconium		Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.4	Chlorine	0.7
Gold		Cerium		Rubidium	0.01	Sulfur	MC
Platinum		Lanthanum		Bromine	0.2	Phosphorus	0.2
Iridium		Barium	0.1	Selenium	≤0.005	Silicon	2
Osmium		Cesium		Arsenic	≤0.003	Aluminum	0.07
Rhenium		Iodine	0.04	Germanium		Magnesium	7
Tungsten		Tellurium		Gallium		Sodium	>8
Tantalum		Antimony		Zinc	0.05	Fluorine	≈0.005
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.002	Carbon	NR
Thulium		Silver		Iron	0.08	Boron	0.003
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.005
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.003 µg/ml
MC — Major Component >10 µg/ml
INT — Interference

Approved: MLJacobson

Date: January 24, 1980

Analyst: J. Oldham

Sample No.: 128-01

IAD No.: 97-D663-377-27

Runoff Pond Water Filtrate CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	0.002
Thorium	<0.02	Gadolinium		Molybdenum *	0.05	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead		Samarium		Zirconium	0.006	Calcium	MC
Thallium		Neodymium		Yttrium	0.003	Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.3	Chlorine	0.1
Gold		Cerium	≤0.003	Rubidium	0.002	Sulfur	5
Platinum		Lanthanum		Bromine	0.05	Phosphorus	0.2
Iridium		Barium	0.1	Selenium	0.01	Silicon	0.8
Osmium		Cesium		Arsenic	0.002	Aluminum	0.7
Rhenium		Iodine	0.03	Germanium		Magnesium	0.5
Tungsten		Tellurium		Gallium	0.003	Sodium	>6
Tantalum		Antimony		Zinc	0.01	Fluorine	≈0.8
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.002	Carbon	NR
Thulium		Silver		Iron	0.5	Boron	<0.001
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	0.006	Lithium	0.001
Dysprosium						Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.002 µg/ml
MC — Major Component > 10 µg/ml
INT — Interference

Approved: ML Jacobs amw

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 141-01

IAD No.: 97-D663-377-27

ROM Coal Pile Particulates CONCENTRATION IN µg/cm^2

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.004	Terbium	0.0004	Ruthenium		Vanadium	0.008
Thorium	0.004	Gadolinium	0.001	Molybdenum	*0.005	Titanium	0.9
Bismuth	0.0003	Europium	0.0006	Niobium	0.005	Scandium	0.0005
Lead	0.05	Samarium	0.002	Zirconium	0.03	Calcium	MC
Thallium		Neodymium	0.01	Yttrium	0.003	Potassium	MC
Mercury	NR	Praseodymium	0.005	Strontium	0.07	Chlorine	0.03
Gold		Cerium	0.01	Rubidium	0.02	Sulfur	>0.6
Platinum		Lanthanum	0.01	Bromine	0.04	Phosphorus	MC
Iridium		Barium	0.1	Selenium	0.001	Silicon	MC
Osmium		Cesium	0.001	Arsenic	0.0009	Aluminum	0.1
Rhenium		Iodine	0.005	Germanium	0.0002	Magnesium	MC
Tungsten	0.0006	Tellurium		Gallium	0.004	Sodium	>0.3
Tantalum		Antimony	*0.002	Zinc	0.03	Fluorine	≈0.1
Hafnium	0.001	Tin	0.0007	Copper	0.05	Oxygen	NR
Lutecium	0.0002	Indium	STD	Nickel	0.004	Nitrogen	NR
Ytterbium	0.001	Cadmium	0.0007	Cobalt	0.002	Carbon	NR
Thulium	0.0001	Silver	≤0.0002	Iron	MC	Boron	0.02
Erbium	0.0004	Palladium		Manganese	0.1	Beryllium	<0.0001
Holmium	0.001	Rhodium		Chromium	0.005	Lithium	0.001
Dysprosium	0.002					Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001 µg/cm^2
MC — Major Component >1 µg/cm^2
INT — Interference

Approved: ML Jacobs cw

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 142-01 Filter

IAD No.: 97-D663-377-27

Rotary Breaker Particulate **CONCENTRATION IN** $\mu g/cm^2$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.0006	Terbium	0.0002	Ruthenium		Vanadium	0.02
Thorium	0.003	Gadolinium	0.001	Molybdenum	0.002	Titanium	MC
Bismuth		Europium	0.0002	Niobium	0.004	Scandium	0.002
Lead	0.01	Samarium	0.002	Zirconium	0.02	Calcium	MC
Thallium		Neodymium	0.002	Yttrium	0.003	Potassium	MC
Mercury	NR	Praseodymium	0.002	Strontium	0.03	Chlorine	0.2
Gold		Cerium	0.01	Rubidium	0.01	Sulfur	0.5
Platinum		Lanthanum	0.02	Bromine	0.02	Phosphorus	0.3
Iridium		Barium	0.1	Selenium	≤0.001	Silicon	MC
Osmium		Cesium	0.001	Arsenic	0.007	Aluminum	>0.08
Rhenium		Iodine	0.002	Germanium	0.0002	Magnesium	MC
Tungsten		Tellurium		Gallium	0.006	Sodium	>0.2
Tantalum		Antimony	0.0003	Zinc	0.05	Fluorine	≃0.07
Hafnium		Tin	≤0.0002	Copper	0.01	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium	0.0003	Cobalt	0.002	Carbon	NR
Thulium	<0.0001	Silver		Iron	MC	Boron	0.008
Erbium	0.0003	Palladium		Manganese	0.1	Beryllium	<0.0001
Holmium	0.0004	Rhodium		Chromium	0.009	Lithium	0.003
Dysprosium	0.0007					Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected $< 0.0001 \mu g/cm^2$
MC — Major Component $> 1 \mu g/cm^2$
INT — Interference

Approved: M L Jacobson

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 143-01 Filter

IAD No.: 97-D663-377-27

Downwind Particulates **CONCENTRATION IN** µg/cm^2

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.002	Terbium	0.0002	Ruthenium		Vanadium	* 0.06
Thorium	0.003	Gadolinium	0.0004	Molybdenum	0.002	Titanium	1
Bismuth		Europium	0.0002	Niobium	0.004	Scandium	0.002
Lead	0.04	Samarium	0.0002	Zirconium	0.1	Calcium	MC
Thallium		Neodymium	0.002	Yttrium	0.007	Potassium	MC
Mercury	NR	Praseodymium	0.002	Strontium	0.06	Chlorine	0.1
Gold		Cerium	0.01	Rubidium	0.02	Sulfur	0.5
Platinum		Lanthanum	0.008	Bromine	0.02	Phosphorus	0.3
Iridium		Barium	0.4	Selenium	0.001	Silicon	MC
Osmium		Cesium	0.0005	Arsenic	0.004	Aluminum	>0.08
Rhenium		Iodine	0.001	Germanium	0.0002	Magnesium	MC
Tungsten		Tellurium		Gallium	0.003	Sodium	>0.2
Tantalum		Antimony	0.0003	Zinc	0.01	Fluorine	≈0.6
Hafnium		Tin	0.0007	Copper	0.02	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.03	Nitrogen	NR
Ytterbium		Cadmium	0.0006	Cobalt	0.0006	Carbon	NR
Thulium		Silver	<0.0001	Iron	MC	Boron	0.08
Erbium	0.0002	Palladium		Manganese	0.08	Beryllium	<0.0001
Holmium	0.0002	Rhodium		Chromium	0.009	Lithium	0.003
Dysprosium	0.0007					Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001µg/cm^2
MC — Major Component > 1µg/cm^2
INT — Interference

Approved: MLJacobs

Date: February 1, 1980

Analyst: J. Oldham

IAD No.: 97-D663-377-27

Sample No.: 144-01

Upwind Particulates CONCENTRATION IN μg/cm²

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.001	Terbium	0.0002	Ruthenium		Vanadium	0.01
Thorium	0.002	Gadolinium	0.0005	Molybdenum	0.002	Titanium	0.5
Bismuth		Europium	0.0002	Niobium	0.005	Scandium	0.0005
Lead	0.02	Samarium	0.001	Zirconium	0.01	Calcium	MC
Thallium		Neodymium	0.001	Yttrium	*0.003	Potassium	MC
Mercury	NR	Praseodymium	0.001	Strontium	0.04	Chlorine	0.1
Gold		Cerium	0.005	Rubidium	0.008	Sulfur	>0.5
Platinum		Lanthanum	0.02	Bromine	0.03	Phosphorus	0.3
Iridium		Barium	*0.4	Selenium	0.002	Silicon	MC
Osmium		Cesium	0.0006	Arsenic	0.004	Aluminum	0.09
Rhenium		Iodine	0.004	Germanium	0.0002	Magnesium	MC
Tungsten		Tellurium	≤0.0002	Gallium	0.003	Sodium	0.2
Tantalum		Antimony	0.0006	Zinc	0.03	Fluorine	≃0.3
Hafnium		Tin	0.0005	Copper	0.03	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.004	Nitrogen	NR
Ytterbium		Cadmium	0.0003	Cobalt	0.0007	Carbon	NR
Thulium		Silver		Iron	MC	Boron	0.08
Erbium	≤0.0002	Palladium		Manganese	*0.1	Beryllium	<0.0001
Holmium	0.003	Rhodium		Chromium	0.01	Lithium	0.001
Dysprosium	0.0004					Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.0001 μg/cm²
MC — Major Component >1 μg/cm²
INT — Interference

Approved: MLJacobs cw

Date: February 1, 1980

Analyst: J. Oldham

IAD No.: 97-D663-377-27

Sample No.: 185-01 Filter

Particulate Blank **CONCENTRATION IN** μg/cm^2

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.0007	Terbium		Ruthenium		Vanadium	* 0.0003
Thorium	<0.0009	Gadolinium		Molybdenum	* 0.004	Titanium	0.03
Bismuth		Europium		Niobium	0.0005	Scandium	≤0.0001
Lead	0.004	Samarium		Zirconium	0.0002	Calcium	MC
Thallium		Neodymium		Yttrium	0.0003	Potassium	MC
Mercury	NR	Praseodymium	0.0001	Strontium	0.002	Chlorine	0.01
Gold		Cerium	0.0008	Rubidium	0.0004	Sulfur	>0.6
Platinum		Lanthanum	0.001	Bromine	0.02	Phosphorus	0.04
Iridium		Barium	0.05	Selenium	≤0.0003	Silicon	MC
Osmium		Cesium		Arsenic	0.0002	Aluminum	>0.1
Rhenium		Iodine	0.0001	Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium	0.0001	Sodium	>0.3
Tantalum		Antimony		Zinc	0.007	Fluorine	*≈0.2
Hafnium		Tin		Copper	0.001	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.001	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	<0.0001	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.09
Erbium		Palladium		Manganese	0.005	Beryllium	<0.0001
Holmium		Rhodium		Chromium	* 0.03	Lithium	0.0006
Dysprosium						Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected <0.0001μg/cm^2
MC — Major Component > 1 μg/cm^2
INT — Interference

Approved: ML Jacobs caw

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 151-01 XAD Resin

IAD No.: 97-D663-377-27

RCM Coal Pile Vapors CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<5	Terbium		Ruthenium		Vanadium	0.2
Thorium	<6	Gadolinium		Molybdenum	7	Titanium	2
Bismuth		Europium		Niobium		Scandium	0.9
Lead	5	Samarium		Zirconium	2	Calcium	78
Thallium		Neodymium		Yttrium		Potassium	100
Mercury	NR	Praseodymium		Strontium	0.5	Chlorine	44
Gold		Cerium		Rubidium		Sulfur	81
Platinum		Lanthanum		Bromine	6	Phosphorus	22
Iridium		Barium	7	Selenium	10	Silicon	89
Osmium		Cesium	10	Arsenic		Aluminum	8
Rhenium		Iodine	6	Germanium		Magnesium	75
Tungsten		Tellurium	≤1	Gallium		Sodium	≤2
Tantalum		Antimony		Zinc	11	Fluorine	≈0.8
Hafnium		Tin		Copper	9	Oxygen	NR
Lutecium		Indium	STD	Nickel	26	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.5	Carbon	NR
Thulium		Silver		Iron	63	Boron	
Erbium		Palladium		Manganese	1	Beryllium	
Holmium		Rhodium		Chromium	3	Lithium	
Dysprosium						Hydrogen	NR

NOTE: Sample ignited in Parr oxygen bomb as per EPA procedures prior to analysis.

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.6 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs cmw

Date: February 4, 1980

Analyst: J. Oldham

Sample No.: 153-01 **IAD No.:** 97-D663-377-27

Downwind Vapors CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<2	Terbium		Ruthenium		Vanadium	0.7
Thorium	<2	Gadolinium		Molybdenum	6	Titanium	26
Bismuth		Europium		Niobium		Scandium	<0.1
Lead	2	Samarium		Zirconium	1	Calcium	130
Thallium		Neodymium		Yttrium		Potassium	920
Mercury	NR	Praseodymium		Strontium	9	Chlorine	51
Gold		Cerium		Rubidium		Sulfur	31
Platinum		Lanthanum		Bromine	2	Phosphorus	17
Iridium		Barium	24	Selenium	≤0.6	Silicon	190
Osmium		Cesium		Arsenic	≤0.1	Aluminum	28
Rhenium		Iodine		Germanium		Magnesium	260
Tungsten		Tellurium		Gallium		Sodium	≤0.7
Tantalum		Antimony		Zinc	15	Fluorine	≈8
Hafnium		Tin		Copper	13	Oxygen	NR
Lutecium		Indium	STD	Nickel	28	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.2	Carbon	NR
Thulium		Silver		Iron	240	Boron	0.8
Erbium		Palladium		Manganese	5	Beryllium	<0.1
Holmium		Rhodium		Chromium	10	Lithium	
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved: MLJacobs cw

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 154-01 XAD Resin

Upwind Vapors

IAD No.: 97-D663-377-27

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<3	Terbium		Ruthenium		Vanadium	0.2
Thorium	<4	Gadolinium		Molybdenum	5	Titanium	5
Bismuth		Europium		Niobium		Scandium	0.5
Lead		Samarium		Zirconium	≤0.7	Calcium	70
Thallium	≤4	Neodymium		Yttrium		Potassium	70
Mercury	NR	Praseodymium		Strontium	0.4	Chlorine	34
Gold		Cerium		Rubidium		Sulfur	14
Platinum		Lanthanum		Bromine	4	Phosphorus	19
Iridium		Barium	2	Selenium		Silicon	62
Osmium		Cesium	* 17	Arsenic		Aluminum	* 150
Rhenium		Iodine	* 2	Germanium		Magnesium	≤4
Tungsten		Tellurium		Gallium		Sodium	≤1
Tantalum		Antimony		Zinc	3	Fluorine	≈0.5
Hafnium		Tin		Copper	24	Oxygen	NR
Lutecium		Indium	STD	Nickel	18	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.2	Carbon	NR
Thulium		Silver		Iron	11	Boron	
Erbium		Palladium		Manganese	0.6	Beryllium	
Holmium		Rhodium		Chromium	1	Lithium	0.5
Dysprosium						Hydrogen	NR

* Heterogeneous

NOTE: Sample ignited in Parr oxygen bomb as per EPA procedures prior to analysis.

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.4 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobs

Date: February 1, 1980

Analyst: J. Oldham

IAD No.: 97-D663-377-27

Sample No.: 152-01 XAD Resin

Rotary Breaker Vapors CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<2	Terbium		Ruthenium		Vanadium	<0.1
Thorium	<2	Gadolinium		Molybdenum	1	Titanium	11
Bismuth		Europium		Niobium		Scandium	<0.1
Lead		Samarium		Zirconium	0.4	Calcium	56
Thallium		Neodymium		Yttrium		Potassium	19
Mercury	NR	Praseodymium		Strontium	0.2	Chlorine	0.9
Gold		Cerium		Rubidium		Sulfur	2
Platinum		Lanthanum		Bromine		Phosphorus	2
Iridium		Barium	3	Selenium		Silicon	8
Osmium		Cesium	0.4	Arsenic		Aluminum	1
Rhenium		Iodine	0.3	Germanium		Magnesium	≤2
Tungsten		Tellurium		Gallium		Sodium	≤0.8
Tantalum		Antimony		Zinc	2	Fluorine	≈0.4
Hafnium		Tin		Copper	1	Oxygen	NR
Lutecium		Indium	STD	Nickel	8	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.4	Carbon	NR
Thulium		Silver		Iron	14	Boron	<0.1
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	1	Lithium	<0.1
Dysprosium						Hydrogen	NR

NOTE: Sample ignited in Parr oxygen bomb as per EPA procedures prior to analysis.

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved:

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 184-01 XAD Resin

IAD No.: 97-D663-377-27

Vapors Blank CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<2	Terbium		Ruthenium		Vanadium	<0.1
Thorium	<2	Gadolinium		Molybdenum	3	Titanium	3
Bismuth		Europium		Niobium		Scandium	≤0.1
Lead		Samarium		Zirconium	15	Calcium	72
Thallium		Neodymium		Yttrium		Potassium	180
Mercury	NR	Praseodymium		Strontium	≤0.2	Chlorine	* 8
Gold		Cerium		Rubidium		Sulfur	16
Platinum	** 0.6	Lanthanum		Bromine	0.5	Phosphorus	17
Iridium		Barium	2	Selenium		Silicon	34
Osmium		Cesium	0.8	Arsenic		Aluminum	9
Rhenium		Iodine	0.3	Germanium		Magnesium	5
Tungsten		Tellurium		Gallium		Sodium	≤0.7
Tantalum		Antimony		Zinc	4	Fluorine	≈0.2
Hafnium	2	Tin		Copper	3	Oxygen	NR
Lutecium		Indium	STD	Nickel	16	Nitrogen	NR
Ytterbium		Cadmium	0.7	Cobalt	≤0.2	Carbon	NR
Thulium		Silver		Iron	22	Boron	<0.1
Erbium		Palladium		Manganese	0.5	Beryllium	
Holmium		Rhodium		Chromium	3	Lithium	0.3
Dysprosium						Hydrogen	NR

* Heterogeneous

** Probable contamination

NOTE: Sample ignited in Parr oxygen bomb as per EPA procedures prior to analysis.

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm
MC — Major Component
INT — Interference

Approved: ML Jacobson

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: XAD Resin Blank

IAD No.: 97-D663-377-27

Duplicate Vapor Blank

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<2	Terbium		Ruthenium		Vanadium	<0.1
Thorium	<3	Gadolinium		Molybdenum	2	Titanium	≤0.1
Bismuth		Europium		Niobium		Scandium	<0.1
Lead		Samarium		Zirconium	2	Calcium	52
Thallium		Neodymium		Yttrium		Potassium	52
Mercury	NR	Praseodymium		Strontium	≤0.2	Chlorine	3
Gold		Cerium		Rubidium		Sulfur	11
Platinum		Lanthanum		Bromine	1	Phosphorus	23
Iridium		Barium	3	Selenium		Silicon	*52
Osmium		Cesium	0.5	Arsenic		Aluminum	4
Rhenium		Iodine	*0.2	Germanium		Magnesium	≤3
Tungsten		Tellurium		Gallium		Sodium	≤1
Tantalum		Antimony		Zinc	2	Fluorine	=0.3
Hafnium		Tin		Copper	2	Oxygen	NR
Lutecium		Indium	STD	Nickel	12	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.1	Carbon	NR
Thulium		Silver		Iron	8	Boron	0.3
Erbium		Palladium		Manganese	0.8	Beryllium	
Holmium		Rhodium		Chromium	0.4	Lithium	0.1
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.3 ppm
MC — Major Component
INT — Interference

NOTE: Sample ignited in Parr oxygen bomb as per EPA procedures prior to analysis.

Approved: ML Jacobson

Date: February 1, 1980

Analyst: J. Oldham

Sample No.: 161-01

IAD No.: 97-D663-377-27

ROM Coal Pile Runoff CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	0.004
Thorium	<0.02	Gadolinium		Molybdenum	0.03	Titanium	0.03
Bismuth		Europium		Niobium	0.01	Scandium	≤0.003
Lead	≤0.009	Samarium		Zirconium	0.01	Calcium	MC
Thallium		Neodymium		Yttrium	0.03	Potassium	MC
Mercury	NR	Praseodymium		Strontium	1	Chlorine	0.5
Gold		Cerium		Rubidium	0.002	Sulfur	MC
Platinum		Lanthanum		Bromine	0.09	Phosphorus	0.1
Iridium		Barium	0.2	Selenium	0.03	Silicon	3
Osmium		Cesium		Arsenic	0.01	Aluminum	0.7
Rhenium		Iodine	0.04	Germanium	0.005	Magnesium	MC
Tungsten	0.01	Tellurium		Gallium	0.002	Sodium	>6
Tantalum		Antimony		Zinc	0.1	Fluorine	≈0.8
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutecium		Indium	STD	Nickel	0.009	Nitrogen	NR
Ytterbium		Cadmium	0.004	Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	5	Boron	<0.001
Erbium		Palladium		Manganese	0.05	Beryllium	
Holmium		Rhodium		Chromium	0.3	Lithium	0.003
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.002 µg/ml
MC — Major Component >10 µg/ml
INT — Interference

Approved: MLJacobs cw

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 171-01 SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS IAD No.: 97-E029-377-15

Clean Coal Leachate CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.02	Terbium		Ruthenium		Vanadium	*<0.001
Thorium	<0.004	Gadolinium		Molybdenum	0.05	Titanium	0.5
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	0.002	Samarium		Zirconium	≤0.001	Calcium	MC
Thallium		Neodymium		Yttrium	0.002	Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.4	Chlorine	0.2
Gold		Cerium		Rubidium	0.004	Sulfur	MC
Platinum		Lanthanum		Bromine	0.04	Phosphorus	0.2
Iridium		Barium	0.6	Selenium	0.005	Silicon	0.2
Osmium		Cesium	0.003	Arsenic	≤0.001	Aluminum	0.02
Rhenium		Iodine	0.002	Germanium		Magnesium	2
Tungsten		Tellurium	0.002	Gallium	<0.001	Sodium	>1
Tantalum		Antimony		Zinc	0.03	Fluorine	≈0.001
Hafnium		Tin		Copper	0.003	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver	0.002	Iron	0.02	Boron	
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.003	Lithium	0.002
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 μg/ml
MC — Major Component >10 μg/ml
INT — Interference

Approved: M J Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 172-01 SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS IAD No.: 97-E029-377-15

ROM Coal Leachate CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.009	Terbium		Ruthenium		Vanadium	<0.001
Thorium	<0.003	Gadolinium		Molybdenum	0.009	Titanium	0.004
Bismuth		Europium		Niobium	<0.001	Scandium	<0.001
Lead	0.006	Samarium		Zirconium	<0.001	Calcium	MC
Thallium		Neodymium		Yttrium	≤0.002	Potassium	MC
Mercury	NR	Praseodymium		Strontium	1	Chlorine	0.04
Gold		Cerium	<0.001	Rubidium	0.01	Sulfur	>2
Platinum		Lanthanum	<0.001	Bromine	0.03	Phosphorus	0.04
Iridium		Barium	0.3	Selenium	0.002	Silicon	0.3
Osmium		Cesium	<0.001	Arsenic	<0.001	Aluminum	0.1
Rhenium		Iodine	0.003	Germanium	<0.001	Magnesium	10
Tungsten		Tellurium	<0.001	Gallium	<0.001	Sodium	>0.8
Tantalum		Antimony		Zinc	0.02	Fluorine	≈0.05
Hafnium		Tin		Copper	0.002	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.003	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver	0.01	Iron	0.02	Boron	<0.001
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.002
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 µg/ml
MC — Major Component >10 µg/ml
INT — Interference

Approved: M S Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 174-01

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

Desilting Pond Sediment Leachate CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	<0.001
Thorium	<0.02	Gadolinium		Molybdenum	0.03	Titanium	0.03
Bismuth		Europium		Niobium		Scandium	≤0.003
Lead	0.04	Samarium		Zirconium	≤0.006	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	3
Mercury	NR	Praseodymium		Strontium	0.09	Chlorine	0.2
Gold		Cerium		Rubidium	0.005	Sulfur	3
Platinum		Lanthanum		Bromine	0.02	Phosphorus	0.2
Iridium		Barium	0.1	Selenium	≤0.003	Silicon	0.8
Osmium		Cesium	<0.001	Arsenic	≤0.001	Aluminum	0.05
Rhenium		Iodine	0.005	Germanium		Magnesium	1
Tungsten		Tellurium		Gallium		Sodium	2
Tantalum		Antimony		Zinc	0.07	Fluorine	≈0.002
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.009	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	*0.1	Boron	<0.001
Erbium		Palladium		Manganese	5	Beryllium	
Holmium		Rhodium		Chromium	≤0.003	Lithium	0.001
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected <0.002 μg/ml
MC — Major Component >10 μg/ml
INT — Interference

Approved: M Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 173-01

Coarse Refuse Leachate

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

CONCENTRATION IN μg/ml

IAD No.: 97-E029-377-15

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.007	Terbium		Ruthenium		Vanadium	0.002
Thorium	<0.008	Gadolinium		Molybdenum	0.008	Titanium	0.2
Bismuth		Europium		Niobium	≤0.002	Scandium	≤0.001
Lead	≤0.004	Samarium		Zirconium	≤0.005	Calcium	MC
Thallium		Neodymium		Yttrium	≤0.006	Potassium	MC
Mercury	NR	Praseodymium		Strontium	3	Chlorine	0.05
Gold		Cerium		Rubidium	0.02	Sulfur	>6
Platinum		Lanthanum		Bromine	0.04	Phosphorus	0.07
Iridium		Barium	0.2	Selenium	0.006	Silicon	0.3
Osmium		Cesium	<0.001	Arsenic	0.002	Aluminum	0.01
Rhenium		Iodine	0.004	Germanium	≤0.004	Magnesium	MC
Tungsten		Tellurium	0.002	Gallium	0.003	Sodium	>2
Tantalum		Antimony	0.002	Zinc	0.02	Fluorine	*≃0.3
Hafnium		Tin		Copper	0.003	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver	0.004	Iron	0.4	Boron	0.002
Erbium		Palladium		Manganese	1	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.06
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 μg/ml
MC — Major Component >10 μg/ml
INT — Interference

Approved: M J Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 176-01

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

Transfer Pond Sediment Leachate CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	≤0.002
Thorium	<0.02	Gadolinium		Molybdenum	*0.07	Titanium	0.03
Bismuth		Europium		Niobium		Scandium	≤0.003
Lead		Samarium		Zirconium	0.006	Calcium	MC
Thallium		Neodymium		Yttrium	≤0.003	Potassium	MC
Mercury	NR	Praseodymium	0.003	Strontium	0.1	Chlorine	0.3
Gold		Cerium	0.02	Rubidium		Sulfur	0.7
Platinum		Lanthanum	0.02	Bromine	0.02	Phosphorus	0.03
Iridium		Barium	0.1	Selenium	≤0.004	Silicon	0.8
Osmium		Cesium		Arsenic	≤0.001	Aluminum	0.03
Rhenium		Iodine	0.005	Germanium		Magnesium	5
Tungsten		Tellurium		Gallium	≤0.002	Sodium	>6
Tantalum		Antimony		Zinc	0.02	Fluorine	≈0.004
Hafnium		Tin		Copper	0.003	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	<0.001	Carbon	NR
Thulium		Silver	0.008	Iron	0.06	Boron	
Erbium		Palladium		Manganese	0.005	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected <0.002 µg/ml
MC — Major Component >10 µg/ml
INT — Interference

Approved: M J Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 176-01

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

Runoff Pond Sediment Leachate

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.01	Terbium		Ruthenium		Vanadium	<0.001
Thorium	<0.01	Gadolinium		Molybdenum	0.008	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead		Samarium		Zirconium	≤0.003	Calcium	MC
Thallium		Neodymium		Yttrium	≤0.002	Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.1	Chlorine	0.2
Gold		Cerium		Rubidium	0.001	Sulfur	MC
Platinum		Lanthanum		Bromine	0.05	Phosphorus	0.3
Iridium		Barium	0.2	Selenium	≤0.002	Silicon	4
Osmium		Cesium	<0.001	Arsenic	≤0.003	Aluminum	0.06
Rhenium		Iodine	0.002	Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium		Sodium	>4
Tantalum		Antimony		Zinc	0.05	Fluorine	≈0.1
Hafnium		Tin		Copper	0.005	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.001	Carbon	NR
Thulium		Silver	0.03	Iron	0.04	Boron	0.002
Erbium		Palladium		Manganese	MC	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.006
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 µg/ml
MC — Major Component >10 µg/ml
INT — Interference

Approved: M J Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 188-01

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

Leachate Blank CONCENTRATION IN g/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.008	Terbium		Ruthenium		Vanadium	<0.001
Thorium	<0.01	Gadolinium	-	Molybdenum	*0.04	Titanium	0.004
Bismuth		Europium		Niobium	0.001	Scandium	<0.001
Lead	0.005	Samarium		Zirconium	0.002	Calcium	2
Thallium		Neodymium		Yttrium	-	Potassium	*0.2
Mercury	NR	Praseodymium		Strontium	0.006	Chlorine	0.1
Gold		Cerium		Rubidium	<0.001	Sulfur	0.08
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.8
Iridium		Barium	*0.03	Selenium	≤0.002	Silicon	*0.8
Osmium		Cesium		Arsenic	≤0.002	Aluminum	*0.02
Rhenium		Iodine	0.002	Germanium		Magnesium	0.01
Tungsten		Tellurium		Gallium	≤0.002	Sodium	0.04
Tantalum		Antimony		Zinc	0.008	Fluorine	≈0.001
Hafnium		Tin		Copper	0.004	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	*<0.001	Carbon	NR
Thulium		Silver		Iron	0.6	Boron	
Erbium		Palladium		Manganese	0.002	Beryllium	
Holmium		Rhodium		Chromium	0.003	Lithium	<0.001
Dysprosium						Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 μg/ml
MC — Major Component >10 μg/ml
INT — Interference

Approved:

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 186-01 Duplicate Leachate Blank

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

CONCENTRATION IN µg/ml

IAD No.: 97-E029-377-15

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	
Thorium	<0.02	Gadolinium		Molybdenum	0.02	Titanium	*0.008
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	≤0.009	Samarium		Zirconium	≤0.003	Calcium	1
Thallium		Neodymium		Yttrium		Potassium	3
Mercury	NR	Praseodymium		Strontium	0.004	Chlorine	0.2
Gold		Cerium		Rubidium		Sulfur	0.2
Platinum		Lanthanum		Bromine		Phosphorus	2
Iridium		Barium	0.01	Selenium		Silicon	0.08
Osmium		Cesium		Arsenic	≤0.001	Aluminum	0.05
Rhenium		Iodine	0.003	Germanium		Magnesium	0.07
Tungsten		Tellurium		Gallium		Sodium	0.6
Tantalum		Antimony		Zinc	0.01	Fluorine	≈0.004
Hafnium		Tin		Copper	0.003	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	<0.001	Carbon	NR
Thulium		Silver		Iron	0.5	Boron	
Erbium		Palladium		Manganese	0.005	Beryllium	
Holmium		Rhodium		Chromium	0.001	Lithium	<0.001
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.002 µg/ml
MC — Major Component >10 ug/ml
INT — Interference

Approved: M Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 187-01

EPA Standard

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

CONCENTRATION IN μg/ml

IAD No.: 97-E029-377-15

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.01	Terbium		Ruthenium		Vanadium	1
Thorium	<0.01	Gadolinium		Molybdenum	0.02	Titanium	*0.08
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	0.3	Samarium		Zirconium	0.008	Calcium	7
Thallium		Neodymium		Yttrium		Potassium	2
Mercury	NR	Praseodymium		Strontium	0.01	Chlorine	0.09
Gold		Cerium		Rubidium	<0.001	Sulfur	0.1
Platinum		Lanthanum		Bromine	0.006	Phosphorus	2
Iridium		Barium	0.04	Selenium	0.05	Silicon	0.06
Osmium		Cesium		Arsenic	0.2	Aluminum	0.5
Rhenium		Iodine		Germanium		Magnesium	0.02
Tungsten		Tellurium		Gallium	≤0.001	Sodium	0.2
Tantalum		Antimony		Zinc	0.2	Fluorine	≃0.003
Hafnium		Tin		Copper	0.2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.09	Nitrogen	NR
Ytterbium		Cadmium	0.005	Cobalt	0.1	Carbon	NR
Thulium		Silver		Iron	1	Boron	<0.001
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	0.5	Lithium	<0.001
Dysprosium						Hydrogen	NR

*Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 μg/ml
MC — Major Component >10 μg/ml
INT — Interference

Approved:

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 189-01

Desilting Pond Sediment Duplicate

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

CONCENTRATION IN μg/ml

IAD No.: 97-E029-377-15

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.02	Terbium		Ruthenium		Vanadium	<0.001
Thorium	<0.02	Gadolinium		Molybdenum	0.006	Titanium	0.03
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead		Samarium		Zirconium	≤0.004	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	6
Mercury	NR	Praseodymium		Strontium	0.004	Chlorine	0.1
Gold		Cerium		Rubidium	<0.001	Sulfur	5
Platinum		Lanthanum		Bromine	0.008	Phosphorus	1
Iridium		Barium	0.06	Selenium	≤0.003	Silicon	0.8
Osmium		Cesium		Arsenic		Aluminum	0.03
Rhenium		Iodine	0.003	Germanium		Magnesium	1
Tungsten		Tellurium		Gallium		Sodium	>6
Tantalum		Antimony		Zinc	0.03	Fluorine	≈0.2
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	*0.03	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.008	Carbon	NR
Thulium		Silver	0.004	Iron	2	Boron	<0.001
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	0.003	Lithium	<0.001
Dysprosium		*Heterogeneous				Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected <0.002 μg/ml
MC — Major Component MC >10 μg/ml
INT — Interference

Approved:

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 190-01

NBS Coal

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-E029-377-15

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	3	Terbium		Ruthenium		Vanadium	67
Thorium	9	Gadolinium		Molybdenum	1	Titanium	MC
Bismuth		Europium	0.5	Niobium	210	Scandium	3
Lead	4	Samarium	4	Zirconium	290	Calcium	MC
Thallium		Neodymium	9	Yttrium	26	Potassium	MC
Mercury	NR	Praseodymium	5	Strontium	81	Chlorine	450
Gold		Cerium	29	Rubidium	44	Sulfur	*MC
Platinum		Lanthanum	46	Bromine	17	Phosphorus	350
Iridium		Barium	540	Selenium	2	Silicon	MC
Osmium		Cesium	3	Arsenic	4	Aluminum	>200
Rhenium		Iodine	0.9	Germanium	0.5	Magnesium	920
Tungsten		Tellurium	0.4	Gallium	17	Sodium	>510
Tantalum		Antimony	6	Zinc	33	Fluorine	≈28
Hafnium		Tin	2	Copper	7	Oxygen	NR
Lutetium		Indium	STD	Nickel	7	Nitrogen	NR
Ytterbium		Cadmium	1	Cobalt	2	Carbon	NR
Thulium		Silver	8	Iron	MC	Boron	47
Erbium		Palladium		Manganese	41	Beryllium	3
Holmium		Rhodium		Chromium	58	Lithium	23
Dysprosium						Hydrogen	NR

* Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm weight
MC — Major Component
INT — Interference

Approved: M L Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 192-01 SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS IAD No.: 97-E029-377-15

USGS S

USGS Sediment CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	18	Terbium	0.7	Ruthenium		Vanadium	340
Thorium	35	Gadolinium	2	Molybdenum	≤0.9	Titanium	MC
Bismuth		Europium	1	Niobium	14	Scandium	5
Lead	16	Samarium	17	Zirconium	130	Calcium	MC
Thallium	≤2	Neodymium	22	Yttrium	53	Potassium	MC
Mercury	NR	Praseodymium	23	Strontium	140	Chlorine	MC
Gold		Cerium	120	Rubidium	170	Sulfur	MC
Platinum		Lanthanum	170	Bromine	78	Phosphorus	MC
Iridium		Barium	MC	Selenium	2	Silicon	MC
Osmium		Cesium	*12	Arsenic	19	Aluminum	>200
Rhenium		Iodine	240	Germanium	5	Magnesium	MC
Tungsten		Tellurium	0.6	Gallium	30	Sodium	>510
Tantalum	≤0.4	Antimony	7	Zinc	290	Fluorine	≈310
Hafnium	2	Tin	2	Copper	68	Oxygen	NR
Lutetium	0.4	Indium	STD	Nickel	83	Nitrogen	NR
Ytterbium	2	Cadmium		Cobalt	7	Carbon	NR
Thulium	0.3	Silver	2	Iron	MC	Boron	47
Erbium	1	Palladium		Manganese	680	Beryllium	0.8
Holmium	2	Rhodium		Chromium	100	Lithium	71
Dysprosium	3					Hydrogen	NR

*Heterogeneous

Note: Sample ground to -200 mesh in agate prior to analysis.

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.2 ppm weight
MC — Major Component
INT — Interference

Approved: MJ Jacobs

Date: March 20, 1980

Analyst: J. Oldham

Sample No.: 194-01 SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS IAD No.: 97-E029-377-15

Method Standard CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	<0.007	Terbium		Ruthenium		Vanadium	0.001
Thorium	<0.008	Gadolinium		Molybdenum	0.03	Titanium	0.04
Bismuth		Europium		Niobium		Scandium	<0.001
Lead		Samarium		Zirconium		Calcium	MC
Thallium		Neodymium		Yttrium	0.03	Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.007	Chlorine	0.2
Gold		Cerium	≤0.001	Rubidium		Sulfur	0.07
Platinum		Lanthanum	0.01	Bromine	0.007	Phosphorus	0.7
Iridium		Barium	0.2	Selenium		Silicon	0.04
Osmium		Cesium		Arsenic	<0.001	Aluminum	0.04
Rhenium		Iodine		Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium	0.03	Sodium	>2
Tantalum		Antimony	0.007	Zinc	0.02	Fluorine	≈0.03
Hafnium		Tin	0.007	Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.001	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.004
Erbium		Palladium		Manganese	<0.001	Beryllium	
Holmium		Rhodium		Chromium	≤0.002	Lithium	0.01
Dysprosium						Hydrogen	NR

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 µg/ml
MC — Major Component MC >10 µg/ml
INT — Interference

Approved:

APPENDIX B

INDUCTIVELY COUPLED ARGON PLASMA DATA FOR LIQUID SAMPLES

Fine Waste Slurry Filtrate
ICP ANALYTICAL REPORT

Date: 4/25/80
Report No:
Batch No.: Delta
Sample No.: 122-02

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		3320.
ANTIMONY		10.	MANGANESE		34.
ARSENIC		NR	MERCURY		NR
BARIUM		157.	MOLYBDENUM		18.
BERYLLIUM		<1.	NICKEL		6.
BORON		239.	POTASSIUM		4500.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		7700.	SILVER		<1.
CHROMIUM		18.	SODIUM		98,400
COBALT		<2.	STRONTIUM		156.
COPPER		<1.	TIN		<10.
GALLIUM		<10.	TITANIUM		189.
IRON		1770.	VANADIUM		12.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		15.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Desilting Pondwater Filtrate

ICP ANALYTICAL REPORT

Date: 4/25/80
Report No:
Batch No.: Delta
Sample No.: 124-02

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		9060.
ANTIMONY		20.	MANGANESE		132.
ARSENIC		NR	MERCURY		NR
BARIUM		68.	MOLYBDENUM		12.
BERYLLIUM		<1.	NICKEL		7.
BORON		164.	POTASSIUM		4200.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		26,900.	SILVER		2.
CHROMIUM		8.	SODIUM		55,400.
COBALT		<2.	STRONTIUM		320.
COPPER		<1.	TIN		<10.
GALLIUM		<10.	TITANIUM		1.
IRON		80.	VANADIUM		1.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		7.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Transfer Pondwater Filtrate

ICP ANALYTICAL REPORT

Date: 4/25/80
Report No:
Batch No.: Delta
Sample No.: 126-02

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		9230.
ANTIMONY		<10.	MANGANESE		127.
ARSENIC		NR	MERCURY		NR
BARIUM		70.	MOLYBDENUM		8.
BERYLLIUM		<1.	NICKEL		<5.
BORON		161.	POTASSIUM		4,600
CADMIUM		<2.	SELENIUM		NR
CALCIUM		27,600.	SILVER		38.
CHROMIUM		<2.	SODIUM		61,600.
COBALT		<2.	STRONTIUM		328.
COPPER		<1.	TIN		<10.
GALLIUM		<10.	TITANIUM		<1.
IRON		30.	VANADIUM		1.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		7.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Runoff Pondwater Filtrate

ICP ANALYTICAL REPORT

Date: 4/25/80

Report No:

Batch No.: Delta

Sample No.: 128-02

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		9,100.
ANTIMONY		30.	MANGANESE		374.
ARSENIC		NR	MERCURY		NR
BARIUM		44.	MOLYBDENUM		11.
BERYLLIUM		2.	NICKEL		12.
BORON		40.	POTASSIUM		2,700.
CADMIUM		4.	SELENIUM		NR
CALCIUM		26,300.	SILVER		16.
CHROMIUM		11.	SODIUM		9,800.
COBALT		<2.	STRONTIUM		117.
COPPER		8.	TIN		<10.
GALLIUM		<10.	TITANIUM		17.
IRON		550.	VANADIUM		8.
LEAD		70.	YTTRIUM		2.
LITHIUM		3.	ZINC		190.

NR - Not Reported

INT - Interference

*(N)- Mean of (N) Analysis

ROM Coal Pile Runoff

ICP ANALYTICAL REPORT

Date: 4/14/80
Report No:
Batch No.: Delta
Sample No.: 162-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		130.	MAGNESIUM		51,500.
ANTIMONY		15.	MANGANESE		20.
ARSENIC		NR	MERCURY		NR
BARIUM		38	MOLYBDENUM		4.
BERYLLIUM		<1.	NICKEL		10.
BORON		33.	POTASSIUM		2,600.
CADMIUM		3.	SELENIUM		NR
CALCIUM		99,000.	SILVER		<30.
CHROMIUM		11.	SODIUM		34,800.
COBALT		2.	STRONTIUM		303.
COPPER		3.	TIN		<10.
GALLIUM		INT	TITANIUM		3.
IRON		152.	VANADIUM		26.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		10.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Clean Coal Leachate

ICP ANALYTICAL REPORT

Date: 4/14/80
Report No:
Batch No.: Delta
Sample No.: 171-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		6,470.
ANTIMONY		<10.	MANGANESE		238.
ARSENIC		NR	MERCURY		NR
BARIUM		90.	MOLYBDENUM		14.
BERYLLIUM		<1.	NICKEL		29.
BORON		161.	POTASSIUM		2,200.
CADMIUM		2.	SELENIUM		NR
CALCIUM		76,400.	SILVER		<30.
CHROMIUM		<2.	SODIUM		20,500.
COBALT		13.	STRONTIUM		422
COPPER		<1.	TIN		15.
GALLIUM		INT	TITANIUM		<1.
IRON		<10.	VANADIUM		<1.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		8.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

ROM Coal Leachate

ICP ANALYTICAL REPORT

Date: 4/14/80

Report No:

Batch No.: Delta

Sample No.: 172-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		13,900.
ANTIMONY		<10.	MANGANESE		424.
ARSENIC		NR	MERCURY		NR
BARIUM		51.	MOLYBDENUM		16.
BERYLLIUM		<1.	NICKEL		41.
BORON		318.	POTASSIUM		9,900.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		105,000.	SILVER		<30.
CHROMIUM		2.	SODIUM		118,000.
COBALT		12.	STRONTIUM		951.
COPPER		<1.	TIN		<10.
GALLIUM		INT	TITANIUM		1.
IRON		<10.	VANADIUM		5.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		26.	ZINC		<50.

NR - Not Reported

INT - Interference

*(N)- Mean of (N) Analysis

Coarse Refuse Leachate

ICP ANALYTICAL REPORT

Date: 4/14/80
Report No:
Batch No.: Delta
Sample No.: 173-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		30.	MAGNESIUM		36,300.
ANTIMONY		19.	MANGANESE		1,080.
ARSENIC		NR	MERCURY		NR
BARIUM		50.	MOLYBDENUM		2.
BERYLLIUM		<1.	NICKEL		192.
BORON		478.	POTASSIUM		19,200.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		<500,000.	SILVER		<30.
CHROMIUM		13.	SODIUM		206,000
COBALT		9.	STRONTIUM		3,000
COPPER		3.	TIN		<10.
GALLIUM		INT	TITANIUM		6.
IRON		14.	VANADIUM		22.
LEAD		<50.	YTTRIUM		2.
LITHIUM		65.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Desilting Pond Sediment Leachate

ICP ANALYTICAL REPORT

Date: 4/14/80
Report No:
Batch No.: Delta
Sample No.: 174-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		3,280.
ANTIMONY		<10.	MANGANESE		847.
ARSENIC		NR	MERCURY		NR
BARIUM		25.	MOLYBDENUM		<2.
BERYLLIUM		<1.	NICKEL		<5.
BORON		54.	POTASSIUM		800.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		6,730.	SILVER		<30.
CHROMIUM		<2.	SODIUM		10,900.
COBALT		<2.	STRONTIUM		43.
COPPER		2.	TIN		<10.
GALLIUM		INT	TITANIUM		<1.
IRON		<10.	VANADIUM		<1.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		<1.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Transfer Pond Sediment Leachate

ICP ANALYTICAL REPORT

Date: 4/14/80
Report No:
Batch No.: Delta
Sample No.: 175-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		8,040.
ANTIMONY		<10.	MANGANESE		10.
ARSENIC		NR	MERCURY		NR
BARIUM		60.	MOLYBDENUM		<2.
BERYLLIUM		<1.	NICKEL		<5.
BORON		41.	POTASSIUM		1,900.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		32,900.	SILVER		<30.
CHROMIUM		<2.	SODIUM		10,000.
COBALT		<2.	STRONTIUM		177.
COPPER		<1.	TIN		<10.
GALLIUM		INT	TITANIUM		<1.
IRON		<10.	VANADIUM		<1.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		2.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

Runoff Pond Sediment Leachate

ICP ANALYTICAL REPORT

Date: 4/14/80
Report No:
Batch No.: Delta
Sample No.: 176-01

CONCENTRATION IN: ppb

ELEMENT:	SSMS:	CONC:	ELEMENT:	SSMS:	CONC:
ALUMINUM		<10.	MAGNESIUM		6,510.
ANTIMONY		<10.	MANGANESE		2,090.
ARSENIC		NR	MERCURY		NR
BARIUM		82.	MOLYBDENUM		<2.
BERYLLIUM		<1.	NICKEL		5.
BORON		31.	POTASSIUM		1,600.
CADMIUM		<2.	SELENIUM		NR
CALCIUM		21,600.	SILVER		<30.
CHROMIUM		<2.	SODIUM		2,600.
COBALT		<2.	STRONTIUM		92.
COPPER		1.	TIN		<10.
GALLIUM		INT	TITANIUM		<1.
IRON		<10.	VANADIUM		<1.
LEAD		<50.	YTTRIUM		<1.
LITHIUM		<1.	ZINC		<50.

NR - Not Reported
INT - Interference
*(N)- Mean of (N) Analysis

APPENDIX C

MERCURY DATA FOR ALL SAMPLES

SUMMARY OF RESULTS: MERCURY ANALYSES

FILTER PADS/FUGITIVE DUSTS ONLY

Enclosed are the data for the analyses of filter pad samples from the coal cleaning plant No. 2. The samples were prepared utilizing the aqua regia digestion procedure described in Appendix D of IERL-RTP Procedures Manual: Level 1 Environmental Assessment (second edition). After preparation, the samples were analyzed according to the following method:

Mercury: Method 245.1 (Manual Cold Vapor Technique)[1]

LEACHATE AND WATER SAMPLES ONLY

Enclosed are the data for the analyses of water samples from the coal cleaning plant No. 2. The samples were analyzed according to the following method:

Mercury: Method 245.1 (Manual Cold Vapor Technique)[1]

Hg ANALYSIS FOR SOLID SAMPLES
(XAD Resin, Soil, Coal)

Enclosed are the Hg data for the analyses of solid samples from the coal cleaning plant No. 2. The samples were prepared utilizing the aqua regia digestion procedure described in Appendix D of IERL-RTP Procedures Manual: Level 1 Environmental Assessment (second edition). After preparation, the samples were analyzed according to the following method:

Mercury: Method 245.1 (Manual Cold Vapor Technique)[1]

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[1] Methods for Chemical Analysis of Water and Wastes, March 1979, EMSL, US EPA, Cinncinati, Chio.

SUMMARY OF RESULTS: MERCURY ANALYSES

WATER SAMPLES ONLY

Enclosed are the data for the analyses of 4 water samples from the coal cleaning plant No. 2. The samples were analyzed according to the following method:

NO. 2.

Mercury: Method 245.1 (Manual Cold Vapor Technique)[1]

FILTER PADS/FUGITIVE DUSTS ONLY

Enclosed are the data for the analyses of 6 filter pad samples from the coal cleaning plant No. 2. The samples were prepared utilizing the aqua regia digestion procedure described in Appendix D of IERL-RTP Procedures Manual: Level 1 Environmental Assessment (second edition). After preparation, the samples were analyzed according to the following method:

Mercury: Method 245.1 (Manual Cold Vapor Technique)[1]

[1] Methods for Chemical Analysis of Water and Wastes, March 1979, EMSL, US EPA, Cinn., Ohio.

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 791 Sample ID No. 101-02

Sample Description Clean Coal (Whole)

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	4.8618 gram/100 ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	5.42 µg/liter
Blank Value	1.22 µg/liter
Corrected Sample Aliquot Value	0.086 µg/gram
Assigned Concentration*	0.09 µg/gram

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 792 Sample ID No. 102-02

Sample Description Clean Coal (crushed)

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	4.5793/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	5.42 ug/ml liter
Blank Value	1.22 ug/ml liter
Corrected Sample Aliquot Value	0.092 ug/gram
Assigned Concentration*	0.09 ug/gram

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 793 Sample ID No. 103-02

Sample Description Fine Refuse (dewatered)

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

.	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	5.1410 gram/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	2.62 ug/st liter
Blank Value	1.22 ug/st liter
Corrected Sample Aliquot Value	0.027 ug/gram
Assigned Concentration*	0.03 ug/gram

*Results: PPM value (in original sample) or I - interference: NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 794 Sample ID No. 104-02

Sample Description ROM Coal

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	5.1411 g/100 ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	8.2278 ug/ml
Blank Value	1.22 ug/liter
Corrected Sample Aliquot Value	0.136 ug/gram
Assigned Concentration*	0.14 ug/gram

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ______

Lab No. 795   Sample ID No. 105-02

Sample Description Course Refuse

Sample Receipt Date ______   Date Analysis Completed ______

Lab Supervisor ______   Date Reported ______

Report Reviewed by ______

Remarks ______

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	5.2601 g/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	10.9226 ug/liter
Blank Value	1.22 ug/liter
Corrected Sample Aliquot Value	0.184 ug/gram
Assigned Concentration*	0.18 ug/gram

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 788 Sample ID No. 106-02

Sample Description

Sample Receipt Date Date Analysis Completed 3/7/80

Lab Supervisor Maxfield Date Reported 3/12/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	5.1950g/100mls
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.0068 ug/liter
Blank Value	0.4194 ug/liter
Corrected Sample Aliquot Value	0.0113 ug/gram
Assigned Concentration*	0.01 ug/gram

*Results: PPM value (in original sample) or I - interference: NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 789 Sample ID No. 107-02

Sample Description Transfer Pond Sediment

Sample Receipt Date Date Analysis Completed 3/7/80

Lab Supervisor Mansfield Date Reported 3/12/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume	5.9249g/100mls
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.0068 ug/liter
Blank Value	0.4194 ug/liter
Corrected Sample Aliquot Value	0.0099 ug/gram
Assigned Concentration*	0.01 ug/gram

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ______

Lab No. 790 Sample ID No. 108-02

Sample Description Runoff Pond Sediment

Sample Receipt Date ______ Date Analysis Completed 3/7/80

Lab Supervisor [illegible] Date Reported 3/12/80

Report Reviewed by ______

Remarks ______

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	4.9805 g/100 ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value (ppm)	0.8894 μg/liter
Blank Value (ppm)	0.4194 μg/liter
Corrected Sample Aliquot Value (ppm)	0.0094 μg/l
Assigned Concentration*	0.01 μg/l

*Results: PPM value (in original sample) or I - interference; NC - not computed; NB - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 803 Sample ID No. 109-02

Sample Description Distilting Pond Filtered Solids

Sample Receipt Date Date Analysis Completed 3/6/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Pad/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.221 ug/liter
Blank Value	1.221 ug/liter
Corrected Sample Aliquot Value	<0.01 ug/pad
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 804 Sample ID No. 110-02

Sample Description Transfer Pond Filtered Solids

Sample Receipt Date Date Analysis Completed 3/6/80

Lab Supervisor Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Pad/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.759 ug/liter
Blank Value	1.221 ug/liter
Corrected Sample Aliquot Value	0.054 ug/pad
Assigned Concentration*	0.05 ug/pad

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 805 Sample ID No. 111-02

Sample Description Runoff Pond Filtered Solid

Sample Receipt Date Date Analysis Completed 3/6/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Pad/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.113 ug/liter
Blank Value	1.221 ug/liter
Corrected Sample Aliquot Value	< 0.01 ug/pad
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 810 Sample ID No. 183-02

Sample Description Filtered Solids Blank

Sample Receipt Date Date Analysis Completed 12-21-79

Lab Supervisor MaxField Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Filter Pad
Dilution Factor	100 ml x 2
Uncorrected Sample Aliquot Value (ppm)	0.0004
Blank Value (ppm)	0.0004
Corrected Sample Aliquot Value (ppm)	< 0.0002 ≡ < 0.02 ug/p
Assigned Concentration*	< 0.02 ug/pad

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 641 Sample ID No. 122-02

Sample Description Fine Water Slurry Filtrate

Sample Receipt Date Date Analysis Completed 12/7/79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	< 0.0002
Blank Value (ppm)	< 0.0002
Corrected Sample Aliquot Value (ppm)	< 0.0002
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference: NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 642 Sample ID No. 124-02

Sample Description Distiling Pond Water

Sample Receipt Date Date Analysis Completed 12/7/79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	< 0.0002
Blank Value (ppm)	< 0.0002
Corrected Sample Aliquot Value (ppm)	< 0.0002
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 643 Sample ID No. 126-02

Sample Description Transfer Pond Water

Sample Receipt Date Date Analysis Completed 12-7-79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	< 0.0002
Blank Value (ppm)	< 0.0002
Corrected Sample Aliquot Value (ppm)	< 0.0002
Assigned Concentration*	N.D

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 644 Sample ID No. 128-02

Sample Description Runoff Pond Water

Sample Receipt Date Date Analysis Completed 12-7-79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	< 0.0002
Blank Value (ppm)	< 0.0002
Corrected Sample Aliquot Value (ppm)	< 0.0002
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ______

Lab No. 806 Sample ID No. 141 -02

Sample Description ROM Coal Pile Particulates

Sample Receipt Date ______ Date Analysis Completed 12 - 21 - 79

Lab Supervisor Maxfield Date Reported ______

Report Reviewed by ______

Remarks ______

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Filter Pad
Dilution Factor	100 ml x 2
Uncorrected Sample Aliquot Value (ppm)	0.0010
Blank Value (ppm)	0.0004
Corrected Sample Aliquot Value (ppm)	0.0012
Assigned Concentration*	0.12 ug/pad

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Rotary Breaker Particulates

Control No.

Lab No. 807 Sample ID No. 142-02

Sample Description Rotary Breaker Particulates

Sample Receipt Date Date Analysis Completed 12-21-79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Filter Pad
Dilution Factor	100 ml X 2
Uncorrected Sample Aliquot Value (ppm)	0.0011
Blank Value (ppm)	0.0004
Corrected Sample Aliquot Value (ppm)	0.0014
Assigned Concentration*	0.14 ug/pad

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 808 Sample ID No. 143-02

Sample Description Downwind Particulates

Sample Receipt Date Date Analysis Completed 12-21-79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	~~100~~ Filter Pad
Dilution Factor	100 ml x 2
Uncorrected Sample Aliquot Value (ppm)	0.0005
Blank Value (ppm)	0.0004
Corrected Sample Aliquot Value (ppm)	0.0002
Assigned Concentration*	0.02 ug/pad

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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4d-5-6

Upwind Part

LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 809 Sample ID No. 144-02

Sample Description Upwind Particulates

Sample Receipt Date Date Analysis Completed 12-21-79

Lab Supervisor Maxfield Date Reported

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Filter Pad
Dilution Factor	100 ml X2
Uncorrected Sample Aliquot Value (ppm)	0.0005
Blank Value (ppm)	0.0004
Corrected Sample Aliquot Value (ppm)	0.0002
Assigned Concentration*	0.02 µg/pad

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

fugitive filter blank 6 of 6

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LABORATORY AAS ANALYSIS SHEET

Control No. ____________________

Lab No. 811   Sample ID No. 185-02

Sample Description Particulate Blank Particulate Blank

Sample Receipt Date ____________ Date Analysis Completed ____________

Lab Supervisor Maxfield   Date Reported ____________

Report Reviewed by ____________________

Remarks ____________________

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Filter Pad
Dilution Factor	100 ml x 2
Uncorrected Sample Aliquot Value (ppm)	0.0004
Blank Value (ppm)	0.0004
Corrected Sample Aliquot Value (ppm)	< 0.0002 ≡
Assigned Concentration*	N.D.

< 0.02 ug/p

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

Versar

LABORATORY AAS ANALYSIS SHEET

Control No. ________

Lab No. 796 Sample ID No. 151-02

Sample Description BOM Coal Pile Vapors

Sample Receipt Date ________ Date Analysis Completed 3/7/90

Lab Supervisor ________ Date Reported 3/9/90

Report Reviewed by ________

Remarks ________

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	4.10314 gram
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.476 ng/liter
Blank Value (ppm)	0.5369 ng/liter
Corrected Sample Aliquot Value (ppm)	0.0229 ng/gram
Assigned Concentration*	0.02 ng/gram

*Results: PPM value (in original sample) or I = interference; NC = not computed; BB = sample value below blank; ND = not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ______

Lab No. 797 Sample ID No. 152-02

Sample Description Rotary Breaker Vapors

Sample Receipt Date ______ Date Analysis Completed 7/7/80

Lab Supervisor MaxField Date Reported 7/7/80

Report Reviewed by ______

Remarks ______

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	3.5475 gram / 100 ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.4768 ug/l [illegible]
Blank Value	0.5368 ug/l [illegible]
Corrected Sample Aliquot Value	0.0265 ug/gm
Assigned Concentration*	0.03 ug/g

*Results: PPM value (in original sample) or I = interference; NC = not computed; NS = sample value below blank; ND = not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ____________________

Lab No. 798 Sample ID No. 153-02

Sample Description - Downwind Vapors

Sample Receipt Date ____________ Date Analysis Completed 3/7/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by ____________________

Remarks ____________________

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	4.9956g/100ml
Dilution Factor	/2
Uncorrected Sample Aliquot Value	1.8294 μg/Blu
Blank Value	0.5368 μg/Blu
Corrected Sample Aliquot Value	0.0259 mg/gm
Assigned Concentration*	0.03 mg/gm

*Results: PPM value (in original sample) or I = interference; NC = not computed; NS = sample value below blank; ND = not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 799 Sample ID No. 154-02

Sample Description Upwind Vapors

Sample Receipt Date Date Analysis Completed 3/7/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	5.9111ℓ/100ℓ
Dilution Factor	1/2
Uncorrected Sample Aliquot Value	2.4170 ug/liter
Blank Value	0.5368 ug/liter
Corrected Sample Aliquot Value	0.0318 ug/[illegible]
Assigned Concentration*	0.03 ug/[illegible]

*Results: PPM value (in original sample) or I = interference; NC = not computed; NI = sample value below blank; ND = not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ______
Lab No. 800 Sample ID No. 184-02
Sample Description Vapors Blank
Sample Receipt Date ______ Date Analysis Completed 3/7/80
Lab Supervisor Maxfield Date Reported 3/7/80
Report Reviewed by ______
Remarks ______

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	5.3040g / [illegible]
Dilution Factor	/2
Uncorrected Sample Aliquot Value (ppm)	2.5344 ug/liter
Blank Value (ppm)	0.5368 ug/liter
Corrected Sample Aliquot Value (ppm)	0.0377 ug/gram
Assigned Concentration*	0.04 ug/gram

*Results: PPM value (in original sample) or I = interference; NC = not computed; NS = sample value below blank; ND = not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 801 Sample ID No. 161-02

Sample Description ROM Coal Pile Runoff

Sample Receipt Date Date Analysis Completed 1/10/80

Lab Supervisor Maxfield Date Reported 3/12/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	1
Uncorrected Sample Aliquot Value (ppm)	0.00023
Blank Value (ppm)	0.00000
Corrected Sample Aliquot Value (ppm)	0.00023
Assigned Concentration*	0.0002 mg/l

*Results: PPM value (in original sample) or I = interference; NC = not computed; NQ = sample value below blank; ND = not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 880 Sample ID No. 162-02

Sample Description ROM Coal Pile Runoff (Duplicate) (Duplicate)

Sample Receipt Date Date Analysis Completed 1/10/80

Lab Supervisor Martell Date Reported 3/12/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	1
Uncorrected Sample Aliquot Value (ppm)	0.00153
Blank Value (ppm)	0.00000
Corrected Sample Aliquot Value (ppm)	0.00153
Assigned Concentration*	0.0015 mg/l

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 765 Sample ID No. 171-01

Sample Description Coal Clean Leachate

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	0.000179
Blank Value (ppm)	~~0.000772~~ 0.000449
Corrected Sample Aliquot Value (ppm)	<0.0005
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 766 Sample ID No. 172-01

Sample Description ROM Coal ROM Coal Leachate

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	0.000503
Blank Value (ppm)	0.000449
Corrected Sample Aliquot Value (ppm)	<0.0005
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 767 Sample ID No. 173-01

Sample Description Coarse Ref Coarse Refuse Leachate

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	0.000718
Blank Value (ppm)	0.000449
Corrected Sample Aliquot Value (ppm)	< 0.0005
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 788 Sample ID No. 174-01

Sample Description Desilting Pone Sediment Leachate

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (μg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	0.000449
Blank Value (ppm)	0.000772
Corrected Sample Aliquot Value (ppm)	< 0.0005
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No. ______

Lab No. 789 Sample ID No. 175-01

Sample Description Transfer Pone Sediment Leachate

Sample Receipt Date ______ Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by ______

Remarks ______

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100 (ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	0.00109
Blank Value (ppm)	0.00077
Corrected Sample Aliquot Value (ppm)	< 0.0005
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<2σ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.

Lab No. 790 Sample ID No. 176-01

Sample Description Runoff Pond Sediment Leachate

Sample Receipt Date Date Analysis Completed 3/5/80

Lab Supervisor Maxfield Date Reported 3/7/80

Report Reviewed by

Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	100
Dilution Factor	None
Uncorrected Sample Aliquot Value (ppm)	0.00093
Blank Value (ppm)	0.00077
Corrected Sample Aliquot Value (ppm)	<0.0005
Assigned Concentration*	N.D.

*Results: PPM value (in original sample) or I - interference; NC - not computed; NG - sample value below blank; ND - not detectable ($<2\sigma$ blank or baseline).

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LABORATORY AAS ANALYSIS SHEET

Control No.
Lab No. 810 Sample ID No. 183-02
Sample Description Glass fiber Filter
Sample Receipt Date Date Analysis Completed 3/6/80
Lab Supervisor Maxfield Date Reported 3/7/80
Report Reviewed by
Remarks

	Hg
Instrument Used	P-E 306
Wavelength Setting (nm)	253.6
Lamp Current (ma)	6
Detection Limit (µg)	0.02
Sensitivity (abs. units/ppm/sample volume)	222/0.010/100(ml)
High/Low Calibration Standards (ppm)	0.0100 - 0.0002
Sample Aliquot Volume (ml)	Pad/[illegible]
Dilution Factor	/2
Uncorrected Sample Aliquot Value	0.790 µg/filter
Blank Value	1.221 µg/filter
Corrected Sample Aliquot Value	< 0.01 µg/pad
Assigned Concentration*	ND

*Results: PPM value (in original sample) or I - interference; NC - not computed; NB - sample value below blank; ND - not detectable (<2σ blank or baseline).

APPENDIX D

WATER QUALITY DATA

SUMMARY OF RESULTS: WATER QUALITY ANALYSES

Enclosed are the data for the water quality analysis of leachate samples from the coal cleaning plant No. 2. The leachate samples were prepared by S. Powers according to the proposed methods for leaching of waste materials by ASTM. One part of wet material was mixed with four parts of deionized water. The procedures used for analysis are referenced below.

COD: Method No. 508, Ref. 1
BOD: Method No. 507, Ref. 1
pH: Method No. 150.1, Ref. 2
Conductivity: Method No. 120.1, Ref. 2
Hardness: Method No. 309B, Ref. 1
Alkalinity: Method No. 310.1, Ref. 2
Acidity: Method No. 305.1, Ref. 2
NH_3-N: Method No. 350.1, Ref. 2
NO_3-N: Method No. 353.2, Ref. 2
NO_2-N: Method No. 353.2, Ref. 2
Total Phosphorus: Method No. 365.2, Ref. 2
Sulfide: Method No. 376.1, Ref. 2
Sulfate: Method No. 375.2, Ref. 2
Fluoride: Method No. 414b, Ref. 1
Chloride: Method No. 325.3, Ref. 2

Ref. 1 - 14th edition, Standard Methods for the Examination of Water and Wastewater, 1975.
Ref. 2 - EPA Methods for Chemical Analysis of Water and Wastes, March 1979.

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LABORATORY WATER QUALITY ANALYSIS

Control No.
Lab No. 765 Sample ID No. 171-01,02,06,07,08,15
Sample Description Clean Coal Leachate
Sample Receipt Date 12-11-79 Date Analysis Completed 2-29-80
Lab Supervisor W. Nivens Date Reported 3-3-80
Report Reviewed By
Remarks

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	237	109	128	5.0	mg/l
BOD_5	14.4	1.0	13.4	1.0	mg/l
pH			7.8		pH units
Conductivity	430	9	421		μmhos/cm
Residual Chlorine	<0.2	<0.2	<0.2	0.2	mg/l
% Solids					
Hardness	212	<1.0	212	1.0	mg/l
Alkalinity	110	2.0	108	1.0	mg/l
Acidity	-109	+1.2	-105	1.0	mg/l
NH_3-N	0.75	<0.05	0.75	0.05	mg/l
NO_3-N	0.07	<0.05	0.07	0.05	mg/l
NO_2-N	<0.05	<0.05	<0.05	0.05	mg/l
Cyanide	<0.02	<0.02	<0.02	0.02	mg/l
Ortho Phosphate					mg/l
Total Phosphorous	0.02	0.02	<0.01	0.01	mg/l
Sulfide	<1.0	<1.0	<1.0	1.0	mg/l
Sulfate	129	1.3	128	1.0	mg/l
F	0.11	<0.05	0.11	0.05	mg/l
Cl	6.0	<1.0	6.0	1.0	mg/l
Sulfite	1.0	<1.0	1.0	1.0	mg/l

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<c blank or baseline).

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LABORATORY WATER QUALITY ANALYSIS

Control No. ______
Lab No. 765 Sample ID No. 171-01,02,06.07,08,15
Sample Description Clean Coal Leachate
Sample Receipt Date 12-11-79 Date Analysis Completed 2-29-80
Lab Supervisor W. Nivens Date Reported 3-3-80
Report Reviewed By ______
Remarks ______

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	237	109	128	5.0	mg/1
BOD$_5$	14.4	1.0	13.4	1.0	mg/1
pH			7.8		pH units
Conductivity	430	9	421		umhos/cm
Residual Chlorine	<0.2	<0.2	<0.2	0.2	mg/1
% Solids					
Hardness	212	<1.0	212	1.0	mg/1
Alkalinity	110	2.0	108	1.0	mg/1
Acidity	-104	-1.2	-105	1.0	mg/1
NH$_3$-N	0.75	<0.05	0.75	0.05	mg/1
NO$_3$-N	0.07	<0.05	0.07	0.05	mg/1
NO$_2$-N	<0.05	<0.05	<0.05	0.05	mg/1
Cyanide	<0.02	<0.02	<0.02	0.02	mg/1
Ortho Phosphate					mg/1
Total Phosphorous	0.02	0.02	<0.01	0.01	mg/1
Sulfide	<1.0	<1.0	<1.0	1.0	mg/1
Sulfate	129	1.3	128	1.0	mg/1
F	0.11	<0.05	0.11	0.05	mg/1
Cl	6.0	<1.0	6.0	1.0	mg/1
Sulfite	1.0	<1.0	1.0	1.0	mg/1

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (≤ blank or baseline).

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LABORATORY WATER QUALITY ANALYSIS

Control No. ________

Lab No. 767   Sample ID No. 173-01,02,06,07 08,15

Sample Description Coarse Refuse Leachate

Sample Receipt Date 12-11-79   Date Analysis Completed 2-29-80

Lab Supervisor W. Nivens   Date Reported 3-3-80

Report Reviewed By ________

Remarks ________

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	136	109	27	5.0	mg/1
BOD_5	3.7	1.0	2.7	1.0	mg/1
pH			7.5		pH units
Conductivity	2400	9	2391		umhos/cm
RESIDUAL CHLORINE	<0.2	<0.2	<0.2	0.2	mg/1
% Solids					
Hardness	1411	<1.0	1411	1.0	mg/1
Alkalinity	236	2.0	234	1.0	mg/1
Acidity	-241	+1.2	-242	1.0	mg/1
NH_3-N	8.10	<0.05	8.10	0.05	mg/1
NO_3-N	0.09	<0.05	0.09	0.05	mg/1
NO_2-N	<0.05	<0.05	<0.05	0.05	mg/1
Cyanide	<0.02	<0.02	<0.02	0.02	mg/1
Ortho Phosphate					mg/1
Total Phosphorous	<0.01	0.02	<0.01	0.01	mg/1
Sulfide	<1.0	<1.0	<1.0	1.0	mg/1
Sulfate	1560	1.3	1559	1.0	mg/1
F	0.16	<0.05	0.16	0.05	mg/1
Cl	<1.0	<1.0	<1.0	1.0	mg/1
Sulfite	<1.0	<1.0	<1.0	1.0	mg/1

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<c blank or baseline).

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LABORATORY WATER QUALITY ANALYSIS

Control No.
Lab No. 766 Sample ID No. 172 - 01,02,06,07,08,15
Sample Description ROM Coal Leachate
Sample Receipt Date 12-11-79 Date Analysis Completed 2-29-80
Lab Supervisor W. Nivens Date Reported 3-3-80
Report Reviewed By
Remarks

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	160	109	51	5.0	mg/1
BOD_5	17.1	1.0	16.1	1.0	mg/1
pH			7.4		pH units
Conductivity	1100	9	1090		µmhos/cm
RESIDUAL CHLORINE	<0.2	<0.2	<0.2	0.2	mg/1
% Solids					
Hardness	317	<1.0	317	1.0	mg/1
Alkalinity	160	2.0	158	1.0	mg/1
Acidity	-114	+1.2	-115	1.0	mg/1
NH_3-N	2.40	<0.05	2.40	0.05	mg/1
NO_3-N	0.11	<0.05	0.11	0.05	mg/1
NO_2-N	<0.05	<0.05	<0.05	0.05	mg/1
Cyanide	<0.02	<0.02	<0.02	0.02	mg/1
Ortho Phosphate					mg/1
Total Phosphorous	<0.01	0.02	<0.01	0.01	mg/1
Sulfide	<1.0	<1.0	<1.0	1.0	mg/1
Sulfate	430	1.3	429	1.0	mg/1
F	0.21	<0.05	0.21	0.05	mg/1
Cl	6.0	<1.0	6.0	1.0	mg/1
Sulfite	<1.0	<1.0	<1.0	1.0	mg/1

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<σ blank or baseline).

Versar inc.

LABORATORY WATER QUALITY ANALYSIS

Control No. ____________________

Lab No. 788 Sample ID No. 174-02

Sample Description Desilting Pond Sediment Leachate

Sample Receipt Date 12-11-79 Date Analysis Completed 2-29-80

Lab Supervisor W. Nivens Date Reported 3-3-80

Report Reviewed By ____________________

Remarks ____________________

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	203	140	63	3.0	mg/1
BOD$_5$	4.0	<1.0	4.0	1.0	mg/1
pH			7.2		pH units
Conductivity	105	9	96		µmhos/cm
RESIDUAL CHLORINE	<0.2	<0.2	<0.2	0.2	mg/1
% Solids					
Hardness	33	2.0	31	1.0	mg/1
Alkalinity	40	2.0	38	1.0	mg/1
Acidity	-33	+1.0	-34	1.0	mg/1
NH$_3$-N	<0.05	<0.05	<0.05	0.05	mg/1
NO$_3$-N	0.13	<0.05	0.13	0.05	mg/1
NO$_2$-N	<0.05	<0.05	<0.05	0.05	mg/1
Cyanide	<0.02	<0.02	<0.02	0.02	mg/1
Ortho Phosphate					mg/1
Total Phosphorous	<0.01	<0.01	<0.01	0.01	mg/1
Sulfide	<1.0	<1.0	<1.0	1.0	mg/1
Sulfate	15	1.3	14	1.0	mg/1
F	0.30	<0.05	0.30	0.05	mg/1
Cl	<1.0	<1.0	<1.0	1.0	mg/1
Sulfite	1.0	<1.0	1.0	1.0	mg/1

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<σ blank or baseline).

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LABORATORY WATER QUALITY ANALYSIS

Control No. ______

Lab No. 789 Sample ID No. 175-02

Sample Description Transfer Pond Sediment Leachate

Sample Receipt Date 12-11-79 Date Analysis Completed 2-29-80

Lab Supervisor W. Nivens Date Reported 3-3-80

Report Reviewed By ______

Remarks ______

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	45	140	NG	5.0	mg/l
BOD_5	2.0	<1.0	2.0	1.0	mg/l
pH			7.9		pH units
Conductivity	220	9	211		µmhos/cm
RESIDUAL CHLORINE	<0.2	<0.2	<0.2	0.2	mg/l
% Solids					
Hardness	119	2.0	117	1.0	mg/l
Alkalinity	124	2.0	122	1.0	mg/l
Acidity	-125	+1.0	-126	1.0	mg/l
NH_3-N	<0.05	<0.05	<0.05	0.05	mg/l
NO_3-N	0.25	<0.05	0.25	0.05	mg/l
NO_2-N	<0.05	<0.05	<0.05	0.05	mg/l
Cyanide	<0.02	<0.02	<0.02	0.02	mg/l
Ortho Phosphate					mg/l
Total Phosphorous	<0.01	<0.01	<0.01	0.01	mg/l
Sulfide	<1.0	<1.0	<1.0	1.0	mg/l
Sulfate	13	1.3	12	1.0	mg/l
F	0.54	<0.05	0.54	0.05	mg/l
Cl	<1.0	<1.0	<1.0	1.0	mg/l
Sulfite	<1.0	<1.0	<1.0	1.0	mg/l

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<σ blank or baseline).

Versar Inc

LABORATORY WATER QUALITY ANALYSIS

Control No.
Lab No. 790 Sample ID No. 176-02
Sample Description Runoff Pond Sediment Leachate
Sample Receipt Date 12-11-79 Date Analysis Completed 2-29-80
Lab Supervisor W. Nivens Date Reported 3-3-80
Report Reviewed By
Remarks

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	109	140	NG	3.0	mg/1
BOD_5	6.4	<1.0	6.4	1.0	mg/1
pH			7.5		pH units
Conductivity	155	9	146		µmhos/cm
RESIDUAL CHLORINE	<0.2	<0.2	<0.2	0.2	mg/1
% Solids					
Hardness	84	2.0	82	1.0	mg/1
Alkalinity	63	2.0	61	1.0	mg/1
Acidity	-55	+1.0	-56	1.0	mg/1
NH_3-N	0.09	<0.05	0.09	0.05	mg/1
NO_3-N	0.14	<0.05	0.14	0.05	mg/1
NO_2-N	<0.05	<0.05	<0.05	0.05	mg/1
Cyanide	<0.02	<0.02	<0.02	0.02	mg/1
Ortho Phosphate					mg/1
Total Phosphorous	0.02	<0.01	0.02	0.01	mg/1
Sulfide	<1.0	<1.0	<1.0	1.0	mg/1
Sulfate	26	1.3	25	1.0	mg/1
F	0.23	<0.05	0.23	0.05	mg/1
Cl	<1.0	<1.0	<1.0	1.0	mg/1
Sulfite	1.0	<1.0	1.0	1.0	mg/1

Results: Concentration measured in original sample on I - interference; NC - not computed; NG - sample value below blank; ND - not detectable (<c blank or baseline).

Versar inc.

LABORATORY WATER QUALITY ANALYSIS

Control No.

Lab No. 633 Sample ID No. 121-05,07

Sample Description Fine Refuse Slurry

Sample Receipt Date 12/4/79 Date Analysis Completed 12/18/79

Lab Supervisor N. Talsania Date Reported 12/27/79

Report Reviewed By

Remarks

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	18.2	<2.0	18.2	2.0	mg/l
BOD_5		<1.0	<18.2	1.0	mg/l
pH					
Conductivity					umhos/cm
TSS		<1.0	38,000	1.0	mg/l
% Solids					
Hardness					mg/l
Alkalinity					mg/l
Acidity					mg/l
NH_3-N					mg/l
NO_3-N					mg/l
NO_2-N					mg/l
Cyanide					mg/l
Ortho Phosphate					mg/l
Total Phosphorous					mg/l
Sulfide					mg/l
Sulfate					mg/l
F					mg/l
Cl					mg/l
Br					mg/l

Versar inc.

LABORATORY WATER QUALITY ANALYSIS

Control No.

Lab No. 633 Sample ID No. 121-05,07

Sample Description Fine Refuse Slurry

Sample Receipt Date 12/4/79 Date Analysis Completed 12/18/79

Lab Supervisor N. Talsania Date Reported 12/27/79

Report Reviewed By

Remarks

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	18.2	<2.0	18.2	2.0	mg/l
BOD_5		<1.0	<18.2	1.0	mg/l
pH					
Conductivity					μmhos/cm
TSS		<1.0	38,000	1.0	mg/l
% Solids					
Hardness					mg/l
Alkalinity					mg/l
Acidity					mg/l
NH_3-N					mg/l
NO_3-N					mg/l
NO_2-N					mg/l
Cyanide					mg/l
Ortho Phosphate					mg/l
Total Phosphorous					mg/l
Sulfide					mg/l
Sulfate					mg/l
F					mg/l
Cl					mg/l
Br					mg/l

Versar inc.

LABORATORY WATER QUALITY ANALYSIS

Control No. ______
Lab No. 635 Sample ID No. 125-05,07
Sample Description Transfer Pond Water
Sample Receipt Date 12/4/79 Date Analysis Completed 12/18/79
Lab Supervisor N. Talsania Date Reported 12/27/79
Report Reviewed By ______
Remarks ______

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	7.3	<2.0	7.3	2.0	mg/l
BOD_5	<1.0	<1.0	<1.0	1.0	mg/l
pH					
Conductivity					umhos/cm
TSS		<1.0	6.5	1.0	mg/l
% Solids					
Hardness					mg/l
Alkalinity					mg/l
Acidity					mg/l
NH_3-N					mg/l
NO_3-N					mg/l
NO_2-N					mg/l
Cyanide					mg/l
Ortho Phosphate					mg/l
Total Phosphorous					mg/l
Sulfide					mg/l
Sulfate					mg/l
F					mg/l
Cl					mg/l
Br					mg/l

Results: Concentration [illegible]

Versar Inc.

LABORATORY WATER QUALITY ANALYSIS

Control No.

Lab No. 634 Sample ID No. 123-05,07

Sample Description Desilting Pond Water

Sample Receipt Date 12/4/79 Date Analysis Completed 12/18/79

Lab Supervisor N. Talsania Date Reported 12/27/79

Report Reviewed By

Remarks

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	7.3	<2.0	7.3	2.0	mg/l
BOD_5	<1.0	<1.0	<1.0	1.0	mg/l
pH					
Conductivity					µmhos/cm
TSS		<1.0	15.8	1.0	mg/l
% Solids					
Hardness					mg/l
Alkalinity					mg/l
Acidity					mg/l
NH_3-N					mg/l
NO_3-N					mg/l
NO_2-N					mg/l
Cyanide					mg/l
Ortho Phosphate					mg/l
Total Phosphorous					mg/l
Sulfide					mg/l
Sulfate					mg/l
F					mg/l
Cl					mg/l
Br					mg/l

Results: Concentration measured in [illegible]

Versar Inc.

LABORATORY WATER QUALITY ANALYSIS

Control No. ______

Lab No. 636 Sample ID No. ______

Sample Description Runoff Pond Water

Sample Receipt Date 12/4/79 Date Analysis Completed 12/18/79

Lab Supervisor N. Talsania Date Reported 12/27/79

Report Reviewed By ______

Remarks ______

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	10.9	<2.0	10.9	1.0	mg/l
BOD_5	1.9	<1.0	1.9	1.0	mg/l
pH					
Conductivity					µmhos/cm
TSS		<1.0	15.9	1.0	mg/l
% Solids					
Hardness					mg/l
Alkalinity					mg/l
Acidity					mg/l
NH_3-N					mg/l
NO_3-N					mg/l
NO_2-N					mg/l
Cyanide					mg/l
Ortho Phosphate					mg/l
Total Phosphorous					mg/l
Sulfide					mg/l
Sulfate					mg/l
F					mg/l
Cl					mg/l
Br					mg/l

[illegible]

Versar INC.

LABORATORY WATER QUALITY ANALYSIS

Control No. ____

Lab No. 802 Sample ID No. 161-07

Sample Description Rom Coal Pile Runoff

Sample Receipt Date 12/11/79 Date Analysis Completed 12/17/79

Lab Supervisor N. Talsania Date Reported 12/27/79

Report Reviewed By ____

Remarks ____

Parameter	Uncorrected Sample Value	Blank Value	Corrected Sample Value	Detection Limit	Assigned Conc.
COD	21.9	<2.0	21.9	2.0	mg/l
BOD_5					mg/l
pH					
Conductivity					umhos/cm
TSS					mg/l
% Solids					
Hardness					mg/l
Alkalinity					mg/l
Acidity					mg/l
NH_3-N					mg/l
NO_3-N					mg/l
NO_2-N					mg/l
Cyanide					mg/l
Ortho Phosphate					mg/l
Total Phosphorous					mg/l
Sulfide					mg/l
Sulfate					mg/l
F					mg/l
Cl					mg/l
Br					mg/l

GLOSSARY

Ames Assay: The Salmonella/Microsome Mutagenesis Assay. This test is used as a primary screen to determine the mutagenic potential of complex mixtures.

CHO Assay: Chinese Hamster Ovary Clonal Assay. This test quantitatively measures the cellular metabolic impairment and death resulting from in vitro exposure to soluble and particulate toxicants.

Discharge Severity (DS): An index of the potential hazard of a single substance in a discharge.

EC_{50}: Median effective concentration. The calculated dose of a chemical substance which is expected to affect 50 percent of an entire population of an experimental animal species as determined from exposure to the substance by any route other than inhalation.

Grav: Gravimetric organics analysis.

ICP-OES: Inductively Coupled Argon Plasma Optical Emission Spectroscopy. An analytical method used primarily to measure the concentration of metals in liquids and solids.

IERL-RTP: Industrial Environmental Research Laboratory at Research Triangle Park, North Carolina.

Level 1: The screening phase in the tiered chemical/biological analysis approach.

Level 2: The confirmation phase in the tiered chemical/biological analysis approach.

Level 3: The risk assessment phase in the tiered chemical/biological analysis approach.

Multimedia Environmental Goals (MEG): Estimated levels of contaminants or degradants in ambient air, water, or land (referred to as AMEG) or in emissions or effluents (referred to as DMEG) conveyed to the ambient media that (1) will not produce negative effects in the surrounding populations or ecosystems, or (2) represent control limits achievable through technology.

RAM Assay: Rabbit Alveolar Macrophage Assay. A bioassay test measuring cytotoxicity using primary cultures of rabbit alveolar (lung) cells. This test defines the cellular toxicity of airborne particulates and associated chemicals.

Rodent Acute In-Vivo Test: A bioassay test measuring whole animal toxicity using rats. Toxicological effects are noted over the following 14-day period.

ROM: Run-of-Mine.

SAM: Source Analysis Model.

SAM/1A: The simplest member of the Source Analysis Models. SAM/1A estimates a Discharge Severity Value equal to the ratio of a specific pollutant concentration in an effluent stream to its corresponding health- or ecological-based mate value.

SSMS: Spark Source Mass Spectrophotometry.

STER: Source Test and Evaluation Report.

TCO: Total Chromatographable Organics.

Total Discharge Severity (TDS): An index of the potential hazard of all substances in a single discharge. Equal to the summation of the individual Discharge Severity Values in a given emission stream.